

**No. 24-7497**  
**Consolidated with Nos. 21-70168, 21-70670**

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**IN THE UNITED STATES COURT OF APPEALS  
FOR THE NINTH CIRCUIT**

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YUROK TRIBE, ALASKA COMMUNITY ACTION ON TOXICS, CENTER  
FOR ENVIRONMENTAL TRANSFORMATION, and  
CONSUMER FEDERATION OF AMERICA,

*Petitioners,*

v.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY  
and LEE ZELDIN, in his official capacity as  
Administrator of the United States Environmental Protection Agency,

*Respondents.*

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On Petitions for Review of Final Agency Actions of the  
United States Environmental Protection Agency  
86 Fed. Reg. 880 (Jan. 6, 2021) and 89 Fed. Reg. 91,486 (Nov. 19, 2024)

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**PETITIONERS' FURTHER EXCERPTS OF RECORD VOLUME 1 OF 1**

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**Economic Analysis for the Final Regulation of  
Decabromodiphenyl ether (DecaBDE) and Phenol, isopropylated  
phosphate (3:1) (PIP (3:1)) Under TSCA Section 6(h)**

RIN 2070-AL02

**October 2024**

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### Notice

This is not an official guidance document and should not be relied upon to determine applicable regulatory requirements. This document was prepared to provide economic information for the rulemaking process and to meet various administrative and legislative requirements. Due to the nature of the information available to EPA, the document contains various assumptions that may not reflect the regulatory determinations that an individual firm would make were it to apply the rule's requirements to its specific circumstances. Persons seeking information on regulatory requirements as they apply to specific facilities should consult 40 CFR part 751, the preamble for the regulatory action, and EPA guidance documents.

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## Acronyms

AIA	Aerospace Industry Association
APF	Assigned Protection Factor
APR	Air Purifying Respirator
ATSDR	Agency for Toxic Substances and Disease Registry
BLS	Bureau of Labor Statistics
CBI	Confidential business information
CDR	Chemical Data Reporting
CFR	Code of Federal Regulations
CHCCs	Chemicals of high concern to children
DecaBDE	Decabromodiphenyl ether
ECEC	Employer Costs for Employee Compensation
EJ	Environmental Justice
EPA	Environmental Protection Agency
EU	European Union
FAA	Federal Aviation Administration
FAST Act	Fixing America's Surface Transportation Act
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act
FR	Final Rule
FRN	Final Rule Notice
GDP	Gross Domestic Product
HIPS	High-impact polystyrene
ICR	Information collection request
IEEE 383	Institute of Electrical and Electronics Engineers 383
IMDS	International Material Data System
IUR	Inventory Update Rule
JMTBA	Japan Machine Tool Builders' Association
LOAEL	Lowest-observed-adverse-effect level
LOEC	Lowest observed effect concentration
MRL	Minimum Risk Level
NAICS	North American Industry Classification System
NEMA	National Electronic Manufacturer's Association
NIOSH	National Institute for Occupational Safety & Health
nonaBDEs	Congeners with 9 bromine atoms
NR	Not reported
NRC	Nuclear Regulatory Commission
NTP	National Toxicology Program
OES	Occupational Employment Statistics
OEWS	Occupational Employment and Wage Statistics
OSHA	Occupational Safety and Health Administration
PBDEs	Polybrominated diphenyl ethers
PBT	Persistent, bioaccumulative, and toxic
PDV	Present discounted value
PFOA	Perfluorooctanoic acid
PIC	Prior Informed Consent
PIP (3:1)	Phenol, isopropylated phosphate (3:1)
PND	Postnatal day
POP	Persistent organic pollutant
POPs	Persistent Organic Pollutants

PPE	Personal protective equipment
PVC	Polyvinyl chloride
RCRA	Resource Conservation and Recovery Act
REACH	Registration, Evaluation, Authorisation and Restriction of Chemicals
RFA	Regulatory Flexibility Act
RY	Reporting Year
SAR	Supplied Air Respirator
SBA	Small Business Administration
SBREFA	Small Business Regulatory Enforcement Fairness Act
SDS	Safety data sheet
SKU	Stock keeping unit
SOC	Standard Occupational Classification
SUSB	Statistics of U.S. Businesses
TDCPP	Tris (1,3-dichloroisopropyl) phosphate
TRI	Toxics Release Inventory
TSCA	Toxic Substances Control Act
TTDs	Target Organ Toxicity Doses
UMRA	Unfunded Mandates Reform Act
VECAP	Voluntary Emissions Control Action Programme
VOC	Volatile Organic Compounds

## Executive Summary

### Introduction

The U.S. Environmental Protection Agency (EPA) is finalizing revisions to the regulations for decabromodiphenyl ether (decaBDE) and phenol, isopropylated phosphate (3:1) (PIP (3:1)), two of the five persistent, bioaccumulative, and toxic (PBT) chemicals addressed in final rules issued under section 6(h) of the Toxic Substances Control Act (TSCA) in January 2021. After receiving additional comments following the issuance of the 2021 PBT final rules, the Agency has determined that revisions to the decaBDE and PIP (3:1) regulations were necessary to address implementation issues and to reduce further exposures. As required under TSCA section 6(h), these finalized requirements will reduce the potential for exposures to humans and the environment to decaBDE and PIP (3:1) to the extent practicable. The Agency is not revising the existing regulations for the other three PBT chemicals (2,4,6-TTBP, HCBD, and PCTP).

EPA requested and received comments on the January 2021 PBT rules following the issuance of Executive Order 13990 (Protecting Public Health and the Environment and Restoring Science to Tackle the Climate Crisis) and other administration priorities. In a March 16, 2021 public notice, EPA asked for comment on additional actions that could be taken to reduce PBT chemical exposures. Information submitted by regulated entities regarding the final rules for decaBDE and PIP (3:1) and EPA's own review of the regulations has led the Agency to determine that amendments to both rules are necessary to further reduce the potential for exposure to the extent practicable.

The Agency published a Notice of Proposed Rulemaking (NPRM) in 2023 and received public comment submissions on the proposed rule from a variety of stakeholders, including industry and trade associations, product manufacturers, chemical users, non-governmental organizations (NGOs), labor advocacy organizations, and Tribal governments (U.S. Environmental Protection Agency (EPA) 2023c). Subsequently, this action finalizes regulatory requirements that will reduce exposures and risks through prohibiting or limiting the processing and distribution of PIP (3:1) and decaBDE and products or articles containing the chemicals and requiring the use of PPE to protect workers. The final rule also prohibits releasing decaBDE to water during manufacturing, processing, and distribution in commerce of decaBDE and decaBDE-containing products. The final options for each chemical use (along with alternative options) for decaBDE and PIP (3:1) are summarized in Table ES- 1 and Table ES-2, respectively. As indicated by TSCA section 6(c)(2)(A)(iv)(II) and (III), EPA must consider and publish a statement based on reasonably available information with respect to the reasonably ascertainable economic consequences of the rule, including consideration of the costs and benefits and the cost effectiveness of the Final Regulatory Action and one or more Primary Alternative regulatory actions considered by the Agency. Therefore, Table ES-1 and Table ES-2 denote both final and primary alternative options.

**Table ES-1: Summary of DecaBDE Risk Management Options**

Chemical Use	Final Option <sup>1</sup>	Primary Alternative Option
Distribution in commerce of decaBDE-containing plastic shipping pallets manufactured before March 8, 2021; and, Processing and distribution in commerce for recycling of decaBDE-containing plastic from products or articles and decaBDE-containing products or articles made from such recycled plastic, where no new decaBDE is added during the recycling process	Require signage providing notice to workers that PPE is required to be worn during the recycling, of plastic shipping pallets, which will reduce potential exposures to decaBDE. Require inhalation and dermal PPE (N95 mask and chemical-resistant gloves) during the recycling process of shipping pallets known to contain decaBDE.	Require a label on all recycled plastic articles containing decaBDE. Require inhalation and dermal PPE (e.g., N95 mask, chemical-resistant gloves) during all recycling processes of plastics.
Manufacture and processing of decaBDE for use in replacement parts and the manufacture of such parts, specifically use in parts installed in and distributed as part of new aerospace vehicles, and the manufacturing and processing of parts to which decaBDE has been added for such vehicles.	Require inhalation and dermal PPE (N95 mask and chemical-resistant gloves), except for the processing of parts to which decaBDE has been added.	No changes from 2021 Final Rule
Manufacture and processing of decaBDE for use in replacement parts and the manufacture of such parts, specifically decaBDE and decaBDE-containing products for use in replacement parts for motor vehicles, and the manufacturing and processing of replacement parts to which decaBDE has been added for such vehicles.	Require inhalation and dermal PPE (N95 mask and chemical-resistant gloves), except for the processing of parts to which decaBDE has been added	No changes from 2021 Final Rule
Releases of decaBDE to water	Prohibit the releases to water during manufacturing, processing, distribution in commerce of decaBDE, decaBDE-containing products, and all persons are required to follow all applicable regulations for preventing the release of decaBDE.	No changes from 2021 Final Rule
Processing and distribution in commerce of decaBDE for use in wire and cable insulation in nuclear power generation facilities	After the end of the wire and cables' service life, all persons are prohibited from all processing and distribution in commerce of decaBDE-containing wire and cable insulation for use in wire and cable insulation in nuclear power generation facilities (including research and test reactors). Require export notification for all persons intending to export decaBDE-containing wire and cable insulation for nuclear power generation facilities.	No changes from 2021 Final Rule

<sup>1</sup> In response to public comments on the NPRM, the final rule also establishes a regulatory threshold level of 0.1%. This amendment in § 751.405 (a) prohibits all manufacturing and processing of decaBDE or decaBDE-containing products or articles after March 8, 2021, and prohibits all distribution in commerce of decaBDE or decaBDE-containing products or articles after January 6, 2022, unless decaBDE concentrations are at or below 0.1% by weight, not including any amount present due to excluded uses, including recycling or phased-out

**Table ES-1: Summary of DecaBDE Risk Management Options**

Chemical Use	Final Option <sup>1</sup>	Primary Alternative Option
uses. As noted in § 751.405 (a)(2), this exclusion does not apply to the processing and distribution in commerce of decaBDE-containing wire and cable insulation for nuclear power generation facilities (including research and test reactors).		

**Table ES- 2: Summary of PIP (3:1) Risk Management Options**

Chemical Use	Final Option <sup>1,2</sup>	Primary Alternative Option
Processing and distribution in commerce for use in lubricants and greases, PIP (3:1) containing products for use in lubricants and greases, and PIP (3:1)-containing lubricants and greases	<p>Modify exclusion for processing and distribution in commerce of PIP (3:1) for use in lubricants and greases and require PPE.</p> <ul style="list-style-type: none"> <li>• Limit this exclusion to only aerospace use and turbine applications.</li> <li>• Add a 15-year time limit to the exclusion for manufacturing, processing and distribution in commerce of any other lubricants and greases that contain PIP (3:1 and PIP (3:1)-containing products for use in); thus, non-turbine and non-aerospace uses will be prohibited after 15 years.</li> <li>• Require a respirator at least as protective as a NIOSH-approved APF 10 air-purifying half mask respirator, and gloves that are chemically resistant to PIP (3:1) with activity-specific training where dermal contact with PIP (3:1) is possible during the manufacturing and processing of PIP (3:1) and PIP (3:1)-containing products for use in lubricants and greases.</li> </ul>	Same as the Final Option, except using a 5-year time limit, rather than 15-years, to the exclusion for manufacturing, processing and distribution in commerce of PIP (3:1) and PIP (3:1)-containing products for use in any other lubricants and greases that contain PIP (3:1) and PIP (3:1)-containing products for use in); thus, non-turbine and non-aerospace uses would be prohibited after 5 years.
Processing and distribution in commerce of new and replacement parts for motor vehicles	<p>Modify compliance dates for processing and distribution in commerce of PIP (3:1) for use in new and replacement parts for motor vehicles and PPE during manufacturing and processing.</p> <ul style="list-style-type: none"> <li>• Prohibit with 15-year phase-in the processing and distribution in commerce of PIP (3:1) and manufacturing, processing, and distribution in commerce of PIP (3:1)-containing products for use in parts for new motor vehicles (i.e., newly produced vehicles), and manufacturing and processing of PIP (3:1)-containing parts for such new vehicles.</li> <li>• Prohibit with 30-year phase-in the processing and distribution in commerce of PIP (3:1) and manufacturing, processing, and distribution in commerce of PIP (3:1)-containing products for use in replacement parts for motor vehicles, and manufacturing and processing of PIP (3:1)-containing replacement parts for such vehicles.</li> <li>• Require a respirator at least as protective as a NIOSH-approved N95 respirator (APF 10) and gloves that are chemically resistant to PIP (3:1) with activity-specific training where dermal contact with PIP (3:1) is possible during manufacturing and processing of PIP (3:1) and PIP (3:1)-containing products for use in new and replacement parts for motor vehicles. Processing of PIP (3:1)-containing parts to which PIP (3:1) has been added are excluded from this requirement.</li> </ul>	No changes from 2021 Final Rule

**Table ES- 2: Summary of PIP (3:1) Risk Management Options**

Chemical Use	Final Option <sup>1,2</sup>	Primary Alternative Option
Processing and distribution in commerce of new and replacement parts for aerospace vehicles	<p>Prohibition phase-in dates for PIP (3:1)-containing new and replacement parts for aerospace vehicles.</p> <ul style="list-style-type: none"> <li>Prohibit the manufacturing, processing and distribution in commerce of PIP (3:1) and PIP (3:1)-containing products for use in new and replacement parts for aerospace vehicles after 30 years;</li> <li>After the end of the aerospace vehicles service lives, prohibit the importing, processing and distribution of aerospace vehicles manufactured before the 30-year prohibition is in effect.</li> <li>Prohibit manufacturing, processing and distribution in commerce of PIP (3:1), PIP (3:1)-containing products, and PIP (3:1)-containing replacement parts after the end of the vehicle service life. (Allow replacement parts that contain PIP (3:1) through the life cycle of the vehicle.)</li> <li>Require a respirator at least as protective as a NIOSH-approved N95 respirator (APF 10) and gloves that are chemically resistant to PIP (3:1) with activity-specific training where dermal contact with PIP (3:1) is possible during manufacturing and processing of PIP (3:1) and PIP (3:1)-containing products for use in new and replacement parts for aerospace vehicles. Processing of PIP (3:1)-containing parts to which PIP (3:1) has been added are excluded from this requirement.</li> </ul>	No changes from 2021 Final Rule
Processing and distribution in commerce for use in wire harnesses and electric circuit boards	<p>Exclusion for the processing and distribution of PIP (3:1), PIP (3:1)-containing products for use in circuit boards and wire harnesses, including but not limited to terminal and fuse covers, cable sleeves, casings, connectors and tapes, and PIP (3:1)-containing circuit boards and wire harnesses including but not limited to terminal and fuse covers, cable sleeves, casings, connectors and tapes.</p> <p>Require a respirator at least as protective as NIOSH-approved APF 10 air-purifying half mask respirator and gloves that are chemically resistant to PIP (3:1) with activity-specific training where dermal contact with PIP (3:1) is possible during manufacturing and processing of PIP (3:1) for use in wire harnesses or electric circuit boards.</p>	Prohibit manufacturing (including import), processing, and distribution and commerce of PIP (3:1) for use in circuit boards and wire harnesses, including but not limited to terminal and fuse covers, cable sleeves, casings, connectors and tapes, and PIP (3:1)-containing circuit boards and wire harnesses including but not limited to terminal and fuse covers, cable sleeves, casings, connectors and tapes, after 20 years.
Manufacturing (import) and distribution in commerce of PIP (3:1) that is intended for formulation into a FIFRA-registered marine antifouling coating	<p>Provide an exclusion of 5 years for the processing and distribution in commerce of PIP (3:1) for use in FIFRA-registered marine anti-fouling coatings only for products that meet Department of Defense specification requirements.</p> <p>Require a respirator at least as protective as a NIOSH-approved APF 10 air-purifying half mask respirator and gloves that are chemically resistant to PIP (3:1) with activity-specific training where dermal contact with PIP (3:1) is possible during manufacturing and processing of PIP (3:1)-for use in FIFRA-registered marine antifouling coating.</p>	

**Table ES- 2: Summary of PIP (3:1) Risk Management Options**

Chemical Use	Final Option <sup>1,2</sup>	Primary Alternative Option
Processing and distribution in commerce for use in semiconductor manufacturing, and electronic, HVACR and water heating, and power generating equipment manufacturing.	<p>Prohibition phase-in dates for PIP (3:1)-containing new and replacement parts for products and articles for use installed in equipment in a variety of industries: manufacturing, semiconductor manufacturing, electronic, HVACR and water heating, and power generating.</p> <ul style="list-style-type: none"><li>• Prohibit the processing and distribution of PIP (3:1) and PIP (3:1)-containing products and articles for use in new parts installed in equipment in a variety of industries: manufacturing, semiconductor manufacturing, electronic, HVACR and water heating, and power generating after 10 years.</li><li>• Prohibit the processing and distribution of PIP (3:1) and PIP (3:1)-containing replacement parts in manufacturing equipment, including semiconductor manufacturing after the end of the products service life.</li><li>• Prohibit the processing and distribution of PIP (3:1) and PIP (3:1)-containing replacement parts in electronic equipment after 7 years for personal use, 25 years for commercial use, and after the products service life for laboratory use.</li><li>• Prohibit the processing and distribution of PIP (3:1) and PIP (3:1)-containing replacement parts in HVACR and water heating equipment after 25 years.</li><li>• Prohibit the processing and distribution of PIP (3:1) and PIP (3:1)-containing replacement parts in power generating equipment after 25 years.</li></ul> <p>Require a respirator at least as protective as a NIOSH-approved APF 10 air-purifying half mask-respirator and gloves that are chemically resistant to PIP (3:1) with activity-specific training where dermal contact with PIP (3:1) is possible during manufacturing and processing for use in PIP (3:1)-containing manufacturing equipment or semiconductors. Processing of PIP (3:1)-containing parts to which PIP (3:1) has been added are excluded from this requirement.</p>	Same as the Final Option, except using a 20-year time limit, rather than 10 years, to the exclusion for manufacturing, processing and distribution in commerce of PIP (3:1) and PIP (3:1)-containing products for use in semiconductor manufacturing, and electronic, HVACR and water heating, and power generating equipment manufacturing.
Processing and distribution in specialized engine filters for locomotive and marine applications	Require half or full respirators, and gloves that are chemically resistant to PIP (3:1) with activity-specific training where dermal contact with PIP (3:1) is possible for workers using PIP (3:1) in the manufacturing of specialized engine filters for locomotive and marine applications. Processing of PIP (3:1)-containing parts are excluded from this requirement.	No changes from 2021 Final Rule
Processing and distribution in intermediate in a closed system to produce cyanoacrylate adhesives	Require respiratory protection that must be at least as protective as a NIOSH-approved APF 50 respirator, except when the PIP (3:1) or PIP (3:1)-containing product is contained in a closed-system. Codify requirements for engineering controls of closed loop, as well as local exhaust ventilation and general ventilation.	No changes from 2021 Final Rule

**Table ES- 2: Summary of PIP (3:1) Risk Management Options**

Chemical Use	Final Option <sup>1,2</sup>	Primary Alternative Option
Processing and distribution in aviation hydraulic fluids	Require a respirator at least as protective as a NIOSH-approved APF 10 air-purifying half mask respirator and gloves that are chemically resistant to PIP (3:1) with activity-specific training where dermal contact with PIP (3:1) is possible during manufacturing and processing of any PIP (3:1)-containing aviation hydraulic fluid.	No changes from 2021 Final Rule

<sup>1</sup> In response to public comments on the NPRM, the final rule also establishes a regulatory threshold level of 0.1%. This exclusion prohibits manufacturing, processing, and distribution in commerce of PIP (3:1)-containing products and articles, unless PIP (3:1) concentrations are at or below 0.1% by weight, not including any amount present due to excluded uses, including recycling, or uses that have not yet been phased out.

<sup>2</sup> EPA is also amending the downstream notification statement that must accompany shipments of PIP (3:1) or PIP (3:1) containing products to conform to the terms of the prohibitions in the final rule. EPA is providing a 3-month transition period to update SDS sheets and an 18-month transition period for updating labels. products. During the 3-month transition period, downstream notification under 40 CFR 751.407(e)(1) and (2) is still required; entities may use the new information provided in new 40 CFR 751.407(e)(3) or existing notification consistent with the restrictions described in this subpart. During the 15-month period between the SDS revision date and the label revision date, manufacturers, processors or distributors are required to provide the updated SDS with the "new" information when distributing products with the "old" label.

### Estimated Number of Affected Entities and Individuals

The number of entities affected by the final rule is estimated based on: 1) identifying specific companies, where possible, or 2) U.S. Census data reporting the number of entities in North American Industry Classification System (NAICS) industries affected by the rule (U.S. Census Bureau 2020). When relying on NAICS-level estimates of the affected industry, the number of entities may be overstated since only some of the entities in each NAICS may be engaged in using or making products or articles containing the regulated chemical. In total, EPA estimates that this rulemaking may affect approximately 26,800 entities under the final option (Table ES-3).

**Table ES- 3: Estimated Number of Entities Affected by Final Rule (Final Option)**

Chemical and Use	Basis	Number of Entities
<b>DecaBDE</b>		
Plastic Shipping Pallets	Identified Companies	1
Replacement Parts for Aerospace Vehicles (makers)	NAICS	0
Replacement Parts for Motor Vehicles (makers)	NAICS	0
Wire and Cable Insulation	Identified Companies	1
<b>All DecaBDE Uses</b>		<b>2</b>
<b>PIP (3:1)</b>		
Lubricants and Greases (except Aerospace and Turbine) (makers)	Identified Companies	5
Lubricants & Greases (Aerospace) (makers)	Identified Companies	11
New and Replacement Parts for Motor Vehicles (consumers)	NAICS	4,562
New and Replacement Parts for Motor Vehicles (makers)	NAICS	8,091
New and Replacement Parts for Aerospace Vehicles (consumers)	NAICS	324
New and Replacement Parts for Aerospace Vehicles (makers)	NAICS	1,787
Wire Harnesses and Electric circuit Boards (makers)	NAICS	1,780
Marine Antifouling Coatings	Identified Companies	1
Articles Used in Manufacturing Equipment, Semiconductor Industry, and HVACR, Power Generating, and Electronic Equipment (makers)	NAICS	1,165
Articles Used in Manufacturing Equipment, Semiconductor Industry, and HVACR, Power Generating, and Electronic Equipment (consumers)	NAICS	9,071
Engine Filters for Locomotive and Marine Applications	Identified Companies	1

**Table ES- 3: Estimated Number of Entities Affected by Final Rule (Final Option)**

Chemical and Use	Basis	Number of Entities
Cyanoacrylate Adhesives	Identified Companies	0
Aviation Hydraulic Fluid (makers)	Identified Companies	5
<b>All PIP (3:1) Uses</b>		<b>26,803</b>
<b>Total</b>		<b>26,805</b>

### Estimated Costs

Total industry costs for the final rule are estimated to be approximately \$400 million (at a 3% discount rate, annualized over 30 years), and \$430 million (at a 7% discount rate). Of the rule costs, those associated with decaBDE alone were approximately \$86 at a 3% discount rate and \$128 at a 7% discount rate. Costs associated with PIP (3:1) were \$400 million and \$430 million (at 3 and 7% discount rates, respectively.) The total industry costs associated with the alternative option were approximately \$829 million and \$821 million (at 3% and 7% discount rates, respectively). Of the alternative option costs, those associated with decaBDE were \$655 and \$656 million (at 3% and 7%) while those for PIP (3:1) were \$173 million and \$165 million (at 3% and 7% discount rates, respectively). Total costs are summarized in Table ES-4.

**Table ES-4: Summary of Total Industry Costs (2022\$)**

Cost Type	Final Option (3%)	Final Option (7%)	Alternative Option (3%)	Alternative Option (7%)
<b>DecaBDE</b>				
Rule Familiarization	\$16	\$25	\$107,684	\$165,436
Prohibition Costs	\$0	\$0	\$0	\$0
Worker Protection	\$13	\$20	\$654,844,921	\$654,895,281
Singage	\$10	\$11	\$400,288	\$614,967
Export Notification	\$47	\$72	\$0	\$0
<b>Total:</b>	<b>\$86</b>	<b>\$128</b>	<b>\$655,352,894</b>	<b>\$655,675,684</b>
<b>PIP (3:1)</b>				
Rule Familiarization	\$211,859	\$325,480	\$85,370	\$131,155
Prohibition Costs	\$27,054,456	\$20,187,608	-\$7,643,116	-\$19,912,918
Worker Protection	\$372,646,017	\$409,516,445	\$180,762,214	\$184,765,958
Singage	\$0	\$0	\$0	\$0
Export Notification	\$0	\$0	\$0	\$0
<b>Total:</b>	<b>\$399,912,332</b>	<b>\$430,029,534</b>	<b>\$173,204,467</b>	<b>\$164,984,194</b>
<b>TOTAL</b>				
Rule Familiarization	\$211,875	\$325,505	\$193,054	\$296,591
Prohibition Costs	\$27,054,456	\$20,187,608	-\$7,643,116	-\$19,912,918
Worker Protection	\$372,646,030	\$409,516,465	\$835,607,135	\$839,661,239
Singage	\$10	\$11	\$400,288	\$614,967
Export Notification	\$47	\$72	\$0	\$0
<b>Total:</b>	<b>\$399,912,418</b>	<b>\$430,029,661</b>	<b>\$828,557,361</b>	<b>\$820,659,879</b>

For this cost analysis, the actions required by manufacturers and processors to comply with the final rule are organized into seven cost categories, summarized below.

1. **Rule Familiarization.** Rule familiarization includes costs incurred by all regulated entities to understand the requirements of the final rule and how the rule applies to their operation. EPA assumes that each manufacturer (including importers) and processor of products subject to the rule who will have PPE requirements will spend 3 hours of professional/technical labor in the first year to become familiar with the requirements of the rule and to develop an understanding of what actions are necessary to comply. EPA assumes firms not subject to PPE requirements will spend 1 hour in the first year on rule familiarization. The total annualized industry cost for rule familiarization, under the final option, using 3% and 7% discount rates, respectively, are approximately \$212,000 and \$326,000. PIP (3:1) accounts for 99 percent of total rule familiarization cost. Under the primary alternative option, the total annualized industry cost for rule familiarization is approximately \$193,000 (3%) and \$297,000 (7%). In this case decaBDE accounts for the majority of costs, about 59 percent. Rule familiarization costs are higher for the alternative option since it requires labelling for all recycled decaBDE-containing articles, whereas the final option only requires posting warning signs where decaBDE-containing plastic pallets are being recycled.
2. **Prohibition.** Prohibition-related costs may result from the need to determine whether components of products may contain the regulated chemical (consumers), and/or to reformulate products or components so that they do not contain the prohibited substance (makers).

Prohibition costs were estimated for companies that manufacture an article containing PIP (3:1) (makers, reformulation costs) and for those who use those articles (consumers, supply chain analysis). Each of these types of costs depend on the number of products/articles affected. For lubricants and greases, EPA identified 18 affected non-aerospace/turbine formulated products. These products are currently available for sale in the United States and EPA expects that the manufacturers will incur costs to reformulate and stop selling them within the prohibition timeframe.

For new and replacement parts for motor vehicles and aerospace vehicles, the number of affected parts is unknown<sup>1</sup>. EPA notes that the rule exempts replacement parts from prohibition until the end of the equipment's service life. EPA uses the number of firms in each affected NAICS code as a proxy for the number of parts. EPA understands that it likely for companies who manufacture affected parts to make more than one, but it is unlikely that every company in the NAICS does make parts using PIP (3:1), so an average of 1 part per company may be reasonable (See Table ES-3, above, for the estimated numbers of affected firms/parts).

Processing and distribution in commerce of PIP (3:1) for use in articles and PIP (3:1)-containing articles, including in articles used in manufacturing equipment and in the semiconductor industry, was prohibited, except for certain exclusions, under the 2021 final rule and the compliance date was extended to October 31, 2024 (40 CFR § 751.401(a)(2)(iii)). For example, this rule prohibits the processing and distribution in commerce of PIP (3:1) for use in articles and PIP (3:1)-containing articles for use in new manufacturing equipment and production and other new equipment used in the semiconductor industry after 10 years. The rule extends the time before a prohibition on these PIP

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<sup>1</sup> As described in Section 3.3.2, the regulated community provided, in comments, lists of potentially affected parts but was not able to determine an exact number, as supply chain analysis is still ongoing. The Aerospace Industries Association (AIA), for example, noted that aerospace products consist of thousands of parts, so EPA believes that the order of magnitude estimated here is accurate.

(3:1) uses goes into effect, therefore it represents a cost savings for these companies, who can postpone their transition costs and have more time to potentially develop more cost-effective alternatives. Due to the compliance delay, reformulation costs will be incurred in a later year than they would be incurred in the baseline and are thus discounted further. The cost savings are the differential between the reformulation costs incurred in the rule scenario and the reformulation costs that would be incurred in the baseline scenario. Similarly, the rule extends the time before a prohibition on the use of PIP (3:1) in marine anti-fouling coatings products. These cost savings are accounted for as negative values in the total cost estimates. There may be additional cost savings if having additional time allows for the development of more cost-effective alternatives. However, these potential savings are not known, and therefore are not quantified.

For the final option, prohibition costs for PIP (3:1) annualized at a 3% discount rate are approximately \$27.0 million and \$20.2 million annualized at a 7% discount rate. For the primary alternative option, prohibitions costs for PIP (3:1) annualized at a 3% discount rate are -\$7.6 million and -\$19.9 million annualized at a 7% discount rate. The negative values represent the cost savings discussed in the preceding paragraph.

3. **Worker Protection.** Worker protection costs include providing workers with the required personal protective equipment (PPE), such as respirators and gloves. The total worker protection costs under the final regulatory option annualized at a 3% discount rate is approximately \$372.6 million and \$409.5 million at a 7% discount rate with PIP (3:1) accounting for all costs. For the primary alternative option, PPE costs to industry are \$835.6 million at a 3% discount rate with decaBDE accounting for \$654.8 million and PIP (3:1) accounting for \$180.8 million. PPE costs to industry total at \$839.6 million at a 7% discount rate for the alternative option with decaBDE accounting for \$654.9 million and PIP (3:1) accounting for \$184.8 million.
4. **Signage in Regulated Areas.** There is only one firm (iGPS) known to recycle pallets and EPA assumes they will post two signs. EPA also assumes each of the signs will be replaced every five years during the period of the analysis, leading to a total of 12 total signs over the 30-year period of the analysis.

For the final option, the total signage costs to industry are about \$10 and \$11 at 3% and 7% discount rates, respectively.

5. **Release Prevention.** This includes costs associated with instituting engineering controls aimed at reducing or eliminating environmental releases of the regulated chemical. Under the final option, EPA prohibits the release of decaBDE to water during manufacture, processing, distribution in commerce. Under this requirement, all persons are required to follow all known regulations to prevent the release of decaBDE and decaBDE-containing product to water during use. EPA contends there are no known releases to water based on the reasonably available information. Therefore, this analysis assumes costs to industry associated with releases to water to be zero.
6. **Export Notification.** This includes costs for required export notifications under TSCA section 12(b) and the provisions of subpart D in 40 CFR part 707 for decaBDE, or products and articles that are known to contain decaBDE. EPA requires that all persons intending to export decaBDE-containing wire and cable for nuclear power generation facilities are required to notify EPA under TSCA section 12(b) and the provisions of subpart D in 40 CFR part 707. The 2020 TSCA Section 12(b) ICR (U.S. Environmental Protection Agency (EPA) 2020d), estimated the annual export notification cost for an exporter under the one-time export notification requirement. These costs include the cost to the exporter of compiling a list of their products that are subject to TSCA Section 12(b) requirements,

writing or revising an export notification letter to EPA, checking the outgoing shipments, and sending the notification letters with the associated shipping costs. Export notification costs to industry total at \$47 annualized at a 3% discount rate and \$72 at a 7% discount rate.

7. **Engineering Control Costs.** EPA is requiring engineering controls for the use of PIP (3:1) in the manufacturing of cyanoacrylate adhesives. According to stakeholders, the production process using PIP (3:1) is carried out in an automated batch distillation plant and in a well ventilated closed system (Henkel Corporation 2019). EPA is requiring engineering controls for the use of PIP (3:1) as an intermediate in the production of cyanoacrylate adhesives such that the processing of PIP (3:1) must take place in a closed loop system and general and local area ventilation must be provided. In codifying these measures, EPA does not intend to supplant OSHA's requirements at 29 CFR 1910.134a (1) which require engineering controls to prevent atmospheric contamination. Given the OSHA requirements that already exist, and the controls already in place by the affected company, EPA believes that this requirement will incur no incremental costs.
8. **Downstream Notification Costs.** EPA is also amending the downstream notification statement that must accompany shipments of PIP (3:1) or PIP (3:1) containing products to conform to the terms of the prohibitions in the final rule. EPA is providing a 3-month transition period to update SDS sheets and an 18-month transition period for updating labels. During the 3-month transition period, downstream notification under 40 CFR 751.407(e)(1) and (2) is still required; entities may use the new information provided in new 40 CFR 751.407(e)(3) or existing notification consistent with the restrictions described in this subpart. During the 15-month period between the SDS revision date and the label revision date, manufacturers, processors or distributors are required to provide the updated SDS with the "new" information when distributing products with the "old" label. Since downstream notification was required in the 2021 PIP (3:1) PBT rule, EPA generally assumes that firms have updated their product's Safety Data Sheets (SDS) in the baseline. EPA acknowledges, however, that some firms may have to update the SDSs to reflect changes associated with requirements of this final rule. EPA believes that the costs of making any minor adjustments to the SDS text needed as a result of this final rule would be minimal, but since the exact number of firms modifying their SDS is unknown, incremental downstream notification costs are not quantified.

EPA notes that while these direct costs associated with rule compliance are incurred by the companies that make the products or articles containing a regulated chemical, a portion – or all – of the cost may be passed through to consumers via price increases. These and other uncertainties are discussed in Section 4.9. Many of the products affected by this regulation are relatively price inelastic with respect to demand due to the nature of their specific industrial use (e.g., aviation hydraulic fluid). Therefore, increases in price are more likely to be passed on to the end-users than to be borne by the manufacturer or processor as a loss in revenue or a shift in market volume. However, given the wide range of products, number of end-users and variability in consumer behavior, EPA was not able to estimate the indirect costs to end-users.

With respect to Agency burden, for the economic analyses for the 2021 final rules, EPA estimated that the Agency needs one full-time equivalent (FTE) employee for implementation (e.g., compliance assistance and enforcement) activities under both the decaBDE and PIP (3:1) rules (two FTEs total). This final rule modifies the existing rules, and EPA does not expect that it will require any additional (incremental) Agency staff time to implement the final rule.<sup>2</sup>

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<sup>2</sup> Note that TSCA Implementation cannot be delegated to states.

## **Estimated Benefits**

The benefits of reducing potential exposure to decaBDE and PIP (3:1) are qualitatively described in this analysis because information required to quantify benefits was not available in the chemical Risk Evaluations. This includes describing specific human and environmental health effects associated with these chemicals as this is crucial to understanding the benefits of reducing exposure potential. Due to data limitations, it is not possible to link exposures to specific uses of decaBDE or PIP (3:1). General exposure considerations and potential health effects (cancer, non-cancer and environmental) are described for each chemical. Most of the information on general exposure considerations and potential health effects is gathered from the U.S. EPA (U.S. Environmental Protection Agency (EPA) 2020b) Use and Exposure Assessment of Five PBT Chemicals, and the Environmental and Human Health Hazards of Five Persistent, Bioaccumulative and Toxic Chemicals (U.S. Environmental Protection Agency (EPA) 2018b).

### **DecaBDE**

Under the final action, workers that may come into contact with decaBDE associated with several uses are required to use worker protection methods (wearing N95 masks and chemical-resistant gloves). Evidence suggests that decaBDE is carcinogenic and the EPA Summary Information on the Integrated Risk Information System (IRIS) (U.S. Environmental Protection Agency (EPA) 2008c) states that “the weight of experimental evidence is on the strong end of the spectrum for the descriptor suggestive evidence of carcinogenic potential, since there is some evidence that decaBDE is carcinogenic in more than one species, sex, and site.” Therefore, this evidence from animal studies suggests that reductions in exposure to decaBDE may lead to decreases in the incidence of liver cancer. Reductions in the exposures to decaBDE may also lead to reductions in developmental neurotoxicity, as well as hepatic, renal, immune and reproductive toxicity. Decreases of decaBDE in the environment may be beneficial for growth and other endpoints in fish, aquatic invertebrates, and terrestrial invertebrates, as evidence indicates both acute and chronic toxicity in these species.

Under EPA’s final regulatory action, inhalation and dermal PPE is required during the recycling process of pallets, as well as use in replacement parts and the manufacture of such parts, containing decaBDE. Additionally, release of decaBDE to water is prohibited during the manufacture, processing, or distribution in commerce. Individuals who may be occupationally exposed in the sectors that use decaBDE under these regulated conditions may experience reduced exposures as a result of the final action.

The primary alternative option would further reduce potential exposure to decaBDE by including the requirement for inhalation and dermal PPE during all recycling processes of plastics and requiring a label on all recycled plastic articles containing decaBDE. Individuals who may be occupationally exposed in the sectors that use decaBDE under these additional regulated conditions would experience further reduced exposures as a result of the alternative option. Individuals who may be occupationally exposed in the sectors that use decaBDE under these regulated conditions will experience a lesser reduction in exposures as a result of the alternative option.

### **PIP (3:1)**

Under the final action, certain uses of PIP (3:1) will be phased out over the next 30 years and worker personal protective equipment (masks, respirators, and gloves) will be required during the manufacturing and processing of PIP (3:1) in certain uses that are not prohibited. For the processing of PIP (3:1) in the manufacturing of cyanoacrylate adhesives, other industry best practices for engineering controls and exhaust ventilation will also be required. Due to exposure to PIP (3:1), data indicate the potential for reproductive and developmental effects, neurological effects and effects on systemic organs. These

regulatory actions would reduce exposure of PIP (3:1) to workers and other potentially susceptible subpopulations as well as the environment.

Under the final regulatory action, prohibitions on the processing and distribution for various uses of PIP (3:1) above a regulatory threshold level of 0.1% by weight are phased in: non-turbine/non-aerospace uses of lubricants and greases (15-year phase-in), new motor vehicle parts (15-year phase-in) and replacement parts (30-year phase-in), aerospace (30-year phase-in), articles in manufacturing equipment and semiconductors (10-year phase in), FIFRA approved marine antifouling coatings products (5-year phase-in). Replacement parts are exempted from the prohibition until after the end of the vehicle's service life for replacement aerospace parts, and equipment's service life for laboratory uses. Replacement parts are exemptions for other uses include 7 years (personal use electronic equipment), 25 years (commercial use electronic equipment, HVACR and water heating equipment, and power generating equipment). Additionally, worker personal protective equipment (masks, respirators, and/or gloves) are required during the manufacturing and processing of PIP (3:1) in certain uses that are not prohibited. Individuals who may be occupationally exposed in the sectors that use PIP (3:1) under these regulated conditions will experience reduced exposures as a result of the final action.

Under the primary alternative option, EPA would have prohibited PIP (3:1) in all lubricants and greases (30-year phase-in) and in articles in manufacturing equipment and semiconductors (20-year phase-in). To the extent that prohibition is delayed under the primary alternative option, benefits would be reduced. However, potential exposure would be mitigated to the extent that personal protective equipment is required until the use is prohibited.

The final action is expected to reduce the exposures to decaBDE and PIP (3:1) and thus have benefits for human health and the environment. Careful selection and avoidance of harmful substitutes for the chemical will help ensure that these benefits are realized. Further research would help characterize the full set of health hazards and environmental concerns associated with decaBDE and PIP (3:1).

## **Estimated Small Business Impacts**

The Regulatory Flexibility Act (RFA) requires an assessment of whether a rule results in “significant (economic) impact on a substantial number of small entities” (SISNOSE) but does not mandate the method to be used for calculating economic impacts nor define the terms “significant” nor “substantial.” The EPA guidance document (U.S. Environmental Protection Agency (EPA) 2006b) does not provide a single preferred method for assessing whether the economic impacts are *significant* or whether the number of entities affected is *substantial*, but generally recommends examining rule compliance costs in relation to resources available to determine the significance of the impacts, and a number and/or percentage measure to determine the extent of the impacts across small entities. The small entity analysis found that of the 24,865 small entities assessed at 3% and 7% discount rates, 860 (3.46%) are expected to incur negative impacts of 1% or greater, under the final action, all of which were for PIP (3:1) and none for decaBDE. The cost per small firm impacted above the 1% or greater threshold ranged from \$21,129 – \$956,719 at a 3% discount rate and ranged from \$21,131 – \$956,726 at a 7% discount rate. No entities for either chemical are expected to incur negative impacts at 3% or greater. Among all small entities, the costs ranged from -\$42 to \$1,146,853 at a 3% discount rate and -\$128 to \$1,272,107 at a 7% discount rate. Negative costs indicate cost savings relative to the 2021 PBT Final Rules.

In accordance with RFA requirements and SBA guidance (SBA, 2017), EPA has prepared a screening analysis to assess small entity impacts. This analysis involved three main steps:

- Identifying the subset of small entities potentially affected by the action based on SBA criteria for each NAICS industry.
- Assessing the potential impact of the rule on those small entities using the cost-to-revenue threshold test. The Agency compared the annualized cost per small entity to annual revenues and identified entities where costs exceed one or three percent of annual revenues<sup>3</sup>; and,
- Based on the results of the threshold test, assessing (1) magnitude of economic impact that may be experienced by regulated small entities; (2) total number of regulated small entities that may experience the economic impact; and (3) percentage of regulated small entities that may experience the economic impact, in order to make a SISNOSE determination

For the firms included in this screening assessment, the extent to which companies would be affected by this rule will depend on whether the chemicals are actually being used, and how they are used.

Furthermore, recent uses of PIP (3:1) are likely being phased out. Therefore, many companies or perhaps entire NAICS categories included may not use the chemicals at all. Therefore, EPA believes that number of firms actually impacted at this level is lower.

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<sup>3</sup> As indicated in (U.S. Small Business Administration (SBA) 2017) and (U.S. Environmental Protection Agency (EPA) 2006a), for small businesses it is appropriate to compare the annualized costs as a percentage of sales (“sales test”) to examine significant economic effect. EPA (2006a) also notes that annualizing the compliance costs is appropriate when a stream of cash flows or a large capital expenditure is involved with compliance, and that revenue or receipts can serve as a reasonable proxy for sales when sales data are unavailable, as is the case in this analysis.

**Table ES- 5: SISNOSE Determination Summary**

Annualization Discount Rate	Affected Businesses	Affected Small Businesses	Range of Costs to Impacted Small Businesses	1% Threshold		3% Threshold	
				Number	Percent	Number	Percent
<b>PIP (3:1)</b>							
3% discount rate	26,803	24,865	-\$42 – \$1,146,853	860	3.46%	0	0%
7% discount rate	26,803	24,865	\$128 – \$1,272,107	860	3.46%	0	0%
<b>DecaBDE</b>							
3% discount rate	2	0	\$0	0	0%	0	0%
7% discount rate	2	0	\$0	0	0%	0	0%

## 1. Introduction

The U.S. Environmental Protection Agency (EPA) is finalizing revisions to the regulations for decabromodiphenyl ether (DecaBDE) and phenol, isopropylated phosphate (3:1) (PIP (3:1)), two of the five persistent, bioaccumulative, and toxic (PBT) chemicals addressed in final rules issued under section 6(h) of the Toxic Substances Control Act (TSCA) in January 2021. After receiving additional comments following the issuance of the 2021 PBT final rules, the Agency has determined that revisions to the decaBDE and PIP (3:1) regulations were necessary to address implementation issues and to reduce further exposures. As required under TSCA section 6(h), these finalized requirements will reduce the potential for exposures to humans and the environment to decaBDE and PIP (3:1) to the extent practicable. The Agency is not revising the existing regulations for the other three PBT chemicals (2,4,6-TTBP, HCBD, and PCTP).

### 1.1 Background

Persistent, bioaccumulative, and toxic (PBT) chemicals are of particular concern with regard to human and environmental health. These chemicals are not easily degraded, so they remain in the environment for long periods of time. Additionally, they will result in biomagnification as they can accumulate up the food chain as they are consumed through each trophic level and have toxic attributes in small quantities. Subsequently, they can cause adverse health and ecological consequences for a substantial amount of time (years to decades or more).

A risk evaluation was not required or contemplated to be conducted for either decaBDE or PIP (3:1). Pursuant to TSCA section 6(h)(2), for chemical substances that meet the criteria of TSCA section 6(h)(1), a risk evaluation is not required for EPA to meet its obligations to address PBT chemicals under TSCA section 6(h)(4). See Unit II.B.3. in the 2021 final rules for decaBDE or PIP (3:1) for more information. This economic analysis addresses EPA's final rule amending requirements for decaBDE and PIP (3:1).

The EPA finalized regulations for five PBT chemicals including decaBDE (86 FR 880, January 6, 2021) and PIP (3:1) (86 FR 894, January 6, 2021) in January 2021. Compliance date extensions were provided for PIP (3:1) on September 17, 2021 (86 FR 51823) and March 8, 2022 (87 FR 12875), with deadlines ultimately extended to October 31, 2024. EPA reasoned that this further extension would avoid significant disruption in the supply chains for certain articles and would provide the public with regulatory certainty, while EPA determined whether any further compliance date extensions were necessary.

EPA requested and received comments on the January 2021 PBT rules following the issuance of Executive Order 13990 (Protecting Public Health and the Environment and Restoring Science to Tackle the Climate Crisis) and other administration priorities. In a March 16, 2021 public notice, EPA asked for comment on additional actions that could be taken to reduce PBT chemical exposures. Information submitted by regulated entities regarding the final rules for decaBDE and PIP (3:1) and EPA's own review of the regulations has led the Agency to determine that amendments to both rules are necessary to further reduce potential exposure to these chemical substances and protect human health and the environment to the extent practicable.

The Agency published a Notice of Proposed Rulemaking (NPRM) in 2023 and received public comment submissions on the proposed rule (88 FR 82287; November 24, 2023). Subsequently, this action finalizes regulatory requirements that will reduce exposures risks through prohibiting or limiting the processing and distribution of PIP (3:1) and decaBDE and products or articles containing these chemicals above a regulatory threshold level of 0.1% by weight and requiring the use of PPE to protect workers. The final

rule also has engineering control requirements for PIP (3:1) and prohibits releasing decaBDE to water during manufacturing, processing, and distribution in commerce, and during commercial use of decaBDE and decaBDE-containing products.

## 1.2 Options Analyzed

Under Section 6(a) of TSCA, the law authorizes EPA to issue regulations requiring one or more of the following actions to the extent necessary so that the chemical substance no longer presents an unreasonable risk:

- Prohibit or otherwise restrict manufacture, processing, or distribution in commerce (§6(a)(1));
- Prohibit or otherwise restrict for a particular use or above a set concentration (§6(a)(2));
- Require minimum warnings and instructions with respect to use, distribution in commerce, or disposal (§6(a)(3));
- Require recordkeeping or testing (§6(a)(4));
- Prohibit or regulate any manner or method of commercial use (§6(a)(5));
- Prohibit or regulate any manner or method of disposal (§6(a)(6)); and/or
- Direct manufacturers or processors to give notice of the unreasonable risk to distributors and replace or repurchase products if required (§6(a)(7)).

According to the 2014 update of the *TSCA Work Plan for Chemical Assessments*, decaBDE and PIP (3:1) have high persistence and high potential for bioaccumulation (U.S. Environmental Protection Agency (EPA) 2014c). The general population, commercial and consumer end-users, other vulnerable subpopulations (workers, children, Tribes) and the environment may be exposed and, if so, negatively affected. EPA is finalizing measures that reduce the amount of decaBDE and PIP (3:1) in the market or limit exposure to these chemicals. For decaBDE, this rule requires use of PPE during manufacturing or processing of products containing decaBDE. For PIP (3:1), this rule prohibits manufacture (including import) after specified periods of time for certain uses and require PPE use for the manufacturing and processing of products and articles that contain PIP (3:1).

The final regulatory action reduces the negative externalities for workers associated with both chemicals. As processing and distribution is generally prohibited unless otherwise excluded, the regulation also eliminates the negative externalities associated with the exposure generally, including by consumers.

As indicated by TSCA section 6(c)(2)(A)(iv)(II) and (III), EPA must consider and publish a statement based on reasonably available information with respect to the reasonably ascertainable economic consequences of the rule, including consideration of the costs and benefits and the cost effectiveness of the Final Regulatory Action and one or more Primary Alternative regulatory actions considered by the Agency.

Table 1-1 and Table 1-2 summarize the risk management options that EPA has chosen for current uses of decaBDE and PIP (3:1) for the Final Regulatory Action and one or more Primary Alternative regulatory actions considered by the Agency.

**Table 1-1: Summary of DecaBDE Risk Management Options**

Chemical Use	Final Option <sup>1</sup>	Primary Alternative Option
Distribution in commerce of decaBDE-containing plastic shipping pallets manufactured before March 8, 2021; and, Processing and distribution in commerce for recycling of decaBDE-containing plastic from products or articles and decaBDE-containing products or articles made from such recycled plastic, where no new decaBDE is added during the recycling process	Require signage providing notice to workers that PPE is required to be worn during the recycling of plastic shipping pallets, which will reduce potential exposures to decaBDE. Require inhalation and dermal PPE (N95 mask and chemical-resistant gloves) during the recycling process of shipping pallets known to contain decaBDE.	Require a label on all recycled plastic articles containing decaBDE. Require inhalation and dermal PPE (e.g., N95 mask, chemical-resistant gloves) during all recycling processes of plastics.
Manufacture and processing of decaBDE for use in replacement parts and the manufacture of such parts, specifically use in parts installed in and distributed as part of new aerospace vehicles, and the manufacturing and processing of parts to which decaBDE has been added for such vehicles.	Require inhalation and dermal PPE (N95 mask and chemical-resistant gloves), except for the processing of parts to which decaBDE has been added.	No changes from 2021 Final Rule
Manufacture and processing of decaBDE for use in replacement parts and the manufacture of such parts, specifically decaBDE and decaBDE-containing products for use in replacement parts for motor vehicles, and the manufacturing and processing of replacement parts to which decaBDE has been added for such vehicles.	Require inhalation and dermal PPE (N95 mask and chemical-resistant gloves), except for the processing of parts to which decaBDE has been added	No changes from 2021 Final Rule
Releases of decaBDE to water	Prohibit the releases to water during manufacturing, processing, distribution in commerce of decaBDE, decaBDE-containing products, and all persons are required to follow all applicable regulations for preventing the release of decaBDE.	No changes from 2021 Final Rule
Processing and distribution in commerce of decaBDE for use in wire and cable insulation in nuclear power generation facilities	After the end of the wire and cables' service life, all persons are prohibited from all processing and distribution in commerce of decaBDE-containing wire and cable insulation for use in wire and cable insulation in nuclear power generation facilities (including research and test reactors). Require export notification for all persons intending to export decaBDE-containing wire and cable insulation for nuclear power generation facilities.	No changes from 2021 Final Rule

<sup>1</sup> In response to public comments on the NPRM, the final rule also establishes a regulatory threshold level of 0.1%. This amendment in § 751.405 (a) prohibits all manufacturing and processing of decaBDE or decaBDE-containing products or articles after March 8, 2021, and prohibits all distribution in commerce of decaBDE or decaBDE-containing products or articles after January 6, 2022, unless decaBDE concentrations are at or below 0.1% by weight, not including any amount present due to excluded uses, including recycling or phased-out uses.

**Table 1-2: Summary of Final PIP (3:1) Risk Management Options**

Chemical Use	Final Option <sup>1,2</sup>	Primary Alternative Regulatory Option
Processing and distribution in commerce for use in lubricants and greases, PIP (3:1) containing products for use in lubricants and greases, and PIP (3:1)-containing lubricants and greases	<p>Modify exclusion for processing and distribution in commerce of PIP (3:1) for use in lubricants and greases and require PPE.</p> <ul style="list-style-type: none"><li>• Limit this exclusion to only aerospace use and turbine applications.</li><li>• Add a 15-year time limit to the exclusion for manufacturing, processing and distribution in commerce of any other lubricants and greases that contain PIP (3:1) and PIP (3:1)-containing products for use in); thus, non-turbine and non-aerospace uses will be prohibited after 15 years.</li><li>• Require a respirator at least as protective as a NIOSH-approved APF 10 air-purifying half mask respirator, and gloves that are chemically resistant to PIP (3:1) with activity-specific training where dermal contact with PIP (3:1) is possible that provide an impervious barrier to prevent dermal exposure during expected durations of use and normal conditions of exposure within the workplace during the manufacturing and processing of PIP (3:1) and PIP (3:1)-containing products for use in lubricants and greases.</li></ul>	Same as the Final Option, except using a 5-year time limit, rather than 15-years, to the exclusion for manufacturing, processing and distribution in commerce of PIP (3:1) and PIP (3:1)-containing products for use in any other lubricants and greases that contain PIP (3:1) and PIP (3:1)-containing products for use in); thus, non-turbine and non-aerospace uses would be prohibited after 5 years.
Processing and distribution in commerce of new and replacement parts for motor vehicles	<p>Modify compliance dates for processing and distribution in commerce of PIP (3:1) for use in new and replacement parts for motor vehicles and PPE during manufacturing and processing.</p> <ul style="list-style-type: none"><li>• Prohibit with 15-year phase-in the processing and distribution in commerce of PIP (3:1) and manufacturing, processing, and distribution in commerce of PIP (3:1)-containing products for use in parts for new motor vehicles (i.e., newly produced vehicles), and manufacturing and processing of PIP (3:1)-containing parts for such new vehicles.</li><li>• Prohibit with 30-year phase-in the processing and distribution in commerce of PIP (3:1) and manufacturing, processing, and distribution in commerce of PIP (3:1)-containing products for use in replacement parts for motor vehicles, and manufacturing and processing of PIP (3:1)-containing replacement parts for such vehicles.</li><li>• Require a respirator at least as protective as a NIOSH-approved N95 respirator (APF 10) and gloves that are chemically resistant to PIP (3:1) with activity-specific training where dermal contact with PIP (3:1) is possible during manufacturing and processing of PIP (3:1) and PIP (3:1)-containing products for use in new and replacement parts for motor vehicles. Processing of PIP (3:1)-containing parts to which PIP (3:1) has been added are excluded from this requirement.</li></ul>	No changes from 2021 Final Rule

<p>Processing and distribution in commerce of new and replacement parts for aerospace vehicles</p>	<p>Prohibition phase-in dates for PIP (3:1)-containing new and replacement parts for aerospace vehicles.</p> <ul style="list-style-type: none"> <li>Prohibit the manufacturing, processing and distribution in commerce of PIP (3:1) and PIP (3:1)-containing products for use in new and replacement parts for aerospace vehicles after 30 years;</li> <li>After the end of the aerospace vehicles service lives, prohibit the importing, processing and distribution of aerospace vehicles manufactured before the 30-year prohibition is in effect.</li> <li>Prohibit manufacturing, processing and distribution in commerce of PIP (3:1), PIP (3:1)-containing products, and PIP (3:1)-containing replacement parts after the end of the vehicle service life. (Allow replacement parts that contain PIP (3:1) through the life cycle of the vehicle.)</li> <li>Require a respirator at least as protective as a NIOSH-approved N95 respirator (APF 10) and gloves that are chemically resistant to PIP (3:1) with activity-specific training where dermal contact with PIP (3:1) is possible during manufacturing and processing of PIP (3:1) and PIP (3:1)-containing products for use in new and replacement parts for aerospace vehicles. Processing of PIP (3:1)-containing parts to which PIP (3:1) has been added are excluded from this requirement.</li> </ul>	<p>No changes from 2021 Final Rule</p>
<p>Processing and distribution in commerce for use in wire harnesses and electric circuit boards</p>	<p>Exclusion for the processing and distribution of PIP (3:1), PIP (3:1)-containing products for use in circuit boards and wire harnesses, including but not limited to terminal and fuse covers, cable sleeves, casings, connectors and tapes, and PIP (3:1)-containing circuit boards and wire harnesses including but not limited to terminal and fuse covers, cable sleeves, casings, connectors and tapes.</p> <ul style="list-style-type: none"> <li>Require a respirator at least as protective as NIOSH-approved APF 10 air-purifying half mask respirator and gloves that are chemically resistant to PIP (3:1) with activity-specific training where dermal contact with PIP (3:1) is possible during manufacturing and processing of PIP (3:1) for use in wire harnesses or electric circuit boards.</li> </ul>	<p>Prohibit manufacturing (including import), processing, and distribution and commerce of PIP (3:1) for use in circuit boards and wire harnesses, including but not limited to terminal and fuse covers, cable sleeves, casings, connectors and tapes, and PIP (3:1)-containing circuit boards and wire harnesses including but not limited to terminal and fuse covers, cable sleeves, casings, connectors and tapes, after 20 years.</p>
<p>Manufacturing (import) and distribution in commerce of PIP (3:1) that is intended for formulation into a FIFRA-registered marine antifouling coating</p>	<p>Provide an exclusion of 5 years for the processing and distribution in commerce of PIP (3:1) for use in FIFRA-registered marine anti-fouling coatings only for products that meet Department of Defense specification requirements.</p> <ul style="list-style-type: none"> <li>Require a respirator at least as protective as a NIOSH-approved APF 10 air-purifying half mask respirator and gloves that are chemically resistant to PIP (3:1) with activity-specific training where dermal contact with PIP (3:1) is possible during manufacturing and processing of PIP (3:1)-for use in FIFRA-registered marine antifouling coating.</li> </ul>	<p>No changes from 2021 final rule</p>

<p>Processing and distribution in commerce for use in semiconductor manufacturing, and electronic, HVACR and water heating, and power generating equipment manufacturing.</p>	<p>Prohibition phase-in dates for PIP (3:1)-containing new and replacement parts for products and articles for use installed in equipment in a variety of industries: manufacturing, semiconductor manufacturing, electronic, HVACR and water heating, and power generating.</p> <ul style="list-style-type: none"> <li>Prohibit the processing and distribution of PIP (3:1) and PIP (3:1)-containing products and articles for use in new parts installed in equipment in a variety of industries: manufacturing, semiconductor manufacturing, electronic, HVACR and water heating, and power generating after 10 years.</li> <li>Prohibit the processing and distribution of PIP (3:1) and PIP (3:1)-containing replacement parts in manufacturing equipment, including semiconductor manufacturing after the end of the products service life.</li> <li>Prohibit the processing and distribution of PIP (3:1) and PIP (3:1)-containing replacement parts in electronic equipment after 7 years for personal use, 25 years for commercial use, and after the products service life for laboratory use.</li> <li>Prohibit the processing and distribution of PIP (3:1) and PIP (3:1)-containing replacement parts in HVACR and water heating equipment after 25 years.</li> <li>Prohibit the processing and distribution of PIP (3:1) and PIP (3:1)-containing replacement parts in power generating equipment after 25 years.</li> <li>Require a respirator at least as protective as a NIOSH-approved APF 10 air-purifying half mask-respirator and gloves that are chemically resistant to PIP (3:1) with activity-specific training where dermal contact with PIP (3:1) is possible during manufacturing and processing for use in PIP (3:1)-containing manufacturing equipment or semiconductors. Processing of PIP (3:1)-containing parts to which PIP (3:1) has been added are excluded from this requirement.</li> </ul>	<p>Same as the Final Option, except using a 20-year time limit, rather than 10 years, to the exclusion for manufacturing, processing and distribution in commerce of PIP (3:1) and PIP (3:1)-containing products for use in semiconductor manufacturing, and electronic, HVACR and water heating, and power generating equipment manufacturing.</p>
<p>Processing and distribution in specialized engine filters for locomotive and marine applications</p>	<p>Require half or full respirators, and gloves that are chemically resistant to PIP (3:1) with activity-specific training where dermal contact with PIP (3:1) is possible for workers using PIP (3:1) in the manufacturing of specialized engine filters for locomotive and marine applications. Processing of PIP (3:1)-containing parts are excluded from this requirement.</p>	<p>No changes from 2021 Final Rule</p>
<p>Processing and distribution in intermediate in a closed system to produce cyanoacrylate adhesives</p>	<p>Require respiratory protection that must be at least as protective as a NIOSH-approved APF 50 respirator, except when the PIP (3:1) or PIP (3:1)-containing product is contained in a closed-system. Codify requirements for engineering controls of closed loop, as well as local exhaust ventilation and general ventilation. - Processing of PIP (3:1)-containing parts to which PIP (3:1) has been added are excluded from this requirement.</p>	<p>No changes from 2021 Final Rule</p>

Processing and distribution in aviation hydraulic fluids	Require a respirator at least as protective as a NIOSH-approved APF 10 air-purifying half mask respirator and gloves that are chemically resistant to PIP (3:1) with activity-specific training where dermal contact with PIP (3:1) is possible during manufacturing and processing of any PIP (3:1)-containing aviation hydraulic fluid.	No changes from 2021 Final Rule
<p><sup>1</sup> In response to public comments on the NPRM, the final rule also establishes a regulatory threshold level of 0.1%. This exclusion prohibits manufacturing, processing, and distribution in commerce of PIP (3:1)-containing products and articles, unless PIP (3:1) concentrations are at or below 0.1% by weight, not including any amount present due to excluded uses, including recycling, or uses that have not yet been phased out.</p> <p><sup>2</sup> EPA is also amending the downstream notification statement that must accompany shipments of PIP (3:1) or PIP (3:1) containing products to conform to the terms of the prohibitions in the final rule. EPA is providing a 3-month transition period to update SDS sheets and an 18-month transition period for updating labels. During the 3-month transition period, downstream notification under 40 CFR 751.407(e)(1) and (2) is still required; entities may use the new information provided in new 40 CFR 751.407(e)(3) or existing notification consistent with the restrictions described in this subpart. During the 15-month period between the SDS revision date and the label revision date, manufacturers, processors or distributors are required to provide the updated SDS with the “new” information when distributing products with the “old” label.</p>		

### 1.3 Organization of this Document

Chapter 2 presents a discussion of the problems with decaBDE and PIP (3:1) that are addressed by the rule. Chapter 3 presents general industry statistics for the sectors expected to be affected under the options. The estimated costs and benefits of the options are presented in Chapter 4 and Chapter 5, respectively. Chapter 6 includes EPA’s analysis of potential small entity impacts, Chapter 7 presents other impact analyses required by statute and Executive Order (E.O.) and Chapter 8 addresses key uncertainties and sensitivities in the analysis. Finally, the references are listed in Chapter 9.

## 2. Problem Definition / Market Failure

Persistent, bioaccumulative, and toxic (PBT) chemicals are of particular concern with regard to human and environmental health. These chemicals are not easily degraded, so they remain in the environment for long periods of time. Additionally, they will result in biomagnification as they can accumulate up the food chain as they are consumed through each trophic level and have toxic attributes in small quantities. Subsequently, they can cause adverse health and ecological consequences for a substantial amount of time (years to decades or more).

Section 6(h) of TSCA, as amended by the Frank R. Lautenberg Chemical Safety for the 21<sup>st</sup> Century Act, requires that EPA take expedited regulatory action to address certain PBT chemicals. To meet this statutory requirement, EPA finalized regulations in January 2021 for five PBT chemicals including decabromodiphenyl ether (DecaBDE) (86 FR 880, January 6, 2021) and Phenol, isopropylated, phosphate (3:1) (PIP (3:1)) (86 FR 894, January 6, 2021). Several stakeholders (e.g., electronics and electrical manufacturing sector and their customers) raised significant concerns about their ability to meet the March 8, 2021,

compliance date for the processing and distribution of PIP (3:1) and PIP (3:1)-containing articles, despite extensive EPA outreach. To address the hardships inadvertently created by the January 2021 final rule on PIP (3:1) due to uses and supply chain challenges that were not communicated to EPA until after the rule was published, compliance date extensions were provided for PIP (3:1) on September 17, 2021 (86 FR 51823) and March 8, 2022 (87 FR 12875) for certain articles until October 30, 2024.

Executive Order 13990 (Protecting Public Health and the Environment and Restoring Science to Tackle the Climate Crisis) established a policy of limiting exposure to dangerous chemicals and pesticides and instructed EPA to prioritize environmental justice when delivering on that goal. Additionally, it directed EPA to review all existing agency actions promulgated, issued, or adopted between January 20, 2017, and January 20, 2021, that were or may have been inconsistent with, or presented obstacles to, the policy of limiting chemical exposure, and as appropriate and consistent with applicable law, to consider suspending, revising, or rescinding the agency actions. In a notice published on March 16, 2021, EPA requested and received comment on the January 2021 PBT rules<sup>4</sup> and additional actions that could be taken to reduce exposures to these PBT chemicals to the extent practicable, including for potentially exposed or susceptible populations and the environment.

### 15 USC §2605(h)

CHEMICALS THAT ARE PERSISTENT, BIOACCUMULATIVE, AND TOXIC.— (1) EXPEDITED ACTION.—Not later than 3 years after the date of enactment of the Frank R. Lautenberg Chemical Safety for the 21st Century Act, the Administrator shall propose rules under subsection (a) with respect to chemical substances identified in the 2014 update of the TSCA Work Plan for Chemical Assessments— (A) that the Administrator has a reasonable basis to conclude are toxic and that with respect to persistence and bioaccumulation score high for 1 and either high or moderate for the other, pursuant to the TSCA Work Plan Chemicals Methods Document published by the Administrator in February 2012 (or a successor scoring system), and are not a metal or metal compound, and for which the Administrator has not completed a Work Plan Problem Formulation, initiated a review under section 5, or entered into a consent agreement under section 4, prior to the date of enactment of the Frank R. Lautenberg Chemical Safety for the 21st Century Act; and (B) exposure to which under the conditions of use is likely to the general population or to a potentially exposed or susceptible subpopulation identified by the Administrator, or the environment, on the basis of an exposure and use assessment conducted by the Administrator.

<sup>4</sup> See announcement at <https://www.epa.gov/newsreleases/epa-seeks-public-comment-protecting-human-health-and-environment-pbt-chemicals>.

The Agency published a Notice of Proposed Rulemaking (NPRM) in 2023 and received public comment submissions on the proposed rule from a variety of stakeholders, including industry and trade associations, product manufacturers, chemical users, non-governmental organizations (NGOs), labor advocacy organizations, and Tribal governments (U.S. Environmental Protection Agency (EPA) 2023c). This action finalizes regulatory requirements that will reduce exposures/risk.

## 2.1 Overview of the Affected Chemical Substances

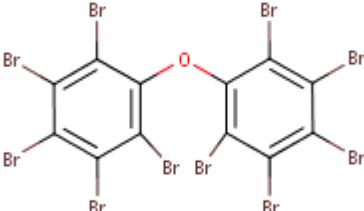
This economic analysis addresses EPA's final rule amending requirements for decaBDE and PIP (3:1).

Pursuant to TSCA section 6(h)(2), for chemical substances that meet the criteria of TSCA section 6(h)(1), a risk evaluation is not required for EPA to meet its obligations to address PBT chemicals under TSCA section 6(h)(4). Thus, a risk evaluation was not required to be conducted for either decaBDE or PIP (3:1). See Unit II.B.3. in the 2021 final rules for decaBDE or PIP (3:1) for more information.

### 2.1.1 Decabromodiphenyl ether (DecaBDE; CAS RN 1163-19-5)

The commercial decaBDE product is composed almost entirely of the single fully brominated congener, known as BDE-209, which has the maximum 10 bromine atoms. DecaBDE products also contain small quantities of nonaBDEs (congeners with nine bromine atoms) (U.S. Environmental Protection Agency (EPA) 2006c). DecaBDE is a PBT chemical that has been used as a brominated flame retardant in a variety of industrial, commercial, and consumer roles including textiles, plastics, adhesives, and polyurethane foam. Primary hazard concerns include carcinogenicity, developmental toxicity, liver effects, and aquatic toxicity. Exposure to individuals in the general population may occur via air and airborne dust, direct skin contact with contaminated dust or by ingestion of contaminated food or drinking water (U.S. Environmental Protection Agency (EPA) 2018c, 2023b). Key identification details of decaBDE are listed in Table 2-1.

**Table 2-1: Chemical Name, Synonyms, and CAS RN for DecaBDE**

<b>Chemical Name</b>	Decabromodiphenyl ether
<b>CAS RN</b>	1163-19-5
<b>Synonyms</b>	1,1'-Oxybis-[2,3,4,5,6-pentabromobenzene]; Bis(pentabromophenyl) ether; Bis(pentabromophenyl) ether; DBDPO; deca-BDE; DecaBDE; Decabromobiphenyl oxide; Decabromobiphenyl ether; decabromodiphenyl oxide; decabromophenyl ether; Pentabromophenyl ether
<b>Molecular Formula</b>	$C_{12}Br_{10}O$
<b>Structure</b>	
<b>Trade Names</b>	BDE-209; Berkflam B 10E; FR 300; FRP 53; BR 55N; Bromkal 82-0DE; Bromkal 83-10DE
<b>Source:</b>	Hazardous Substances Data Bank (HSDB) 2017

DecaBDE's assessment scores from the 2014 update of the *TSCA Work Plan for Chemical Assessments* (U.S. Environmental Protection Agency (EPA) 2014c) are summarized in Table 2-2. Possible scores

ranged from 1 to 3, with 3 representing the most adverse score. As can be seen in the table, persistence and bioaccumulation are a concern for the chemical. While each chemical on the TSCA Work Plan for Chemical Assessments was given an exposure score, TSCA section 6(h)(1)(B) directs EPA to determine whether exposure to the PBT chemicals is likely based on an exposure and use assessment. EPA has determined that, based on the Exposure and Use Assessment of Five Persistent, Bioaccumulative and Toxic Chemicals (U.S. Environmental Protection Agency (EPA) 2020b) and other reasonably available information, exposure to the five PBT chemicals under the conditions of use is likely to the general population, to a potentially exposed or susceptible subpopulation, or the environment. EPA's final determination is based on the opportunities for exposure throughout the lifecycle of each of the five PBT chemicals, including decaBDE.

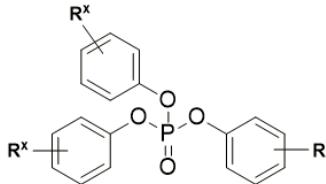
**Table 2-2: Hazard, Exposure, and Persistence & Bioaccumulation Scores for DecaBDE**

Chemical Name	CAS RN	Hazard Score	Exposure Score	Persistence & Bioaccumulation Score
Decabromodiphenyl ether (DecaBDE)	1163-19-5	3	3	3
<b>Note:</b>				
3 = High, 2 = Moderate, 1 = Low.				
<b>Source:</b> (U.S. Environmental Protection Agency (EPA) 2014c)				

### 2.1.2 Phenol, isopropylated, phosphate (3:1) (PIP (3:1); CAS RN 68937-41-7)

PIP (3:1) is a non-halogenated aromatic phosphate compound, containing not a single chemical but a mixture of as many as fifty unspecified isomers. Different commercial products contain varying amounts of different isomers ranging from isopropyl phenyl diphenyl phosphate to tris(isopropylphenyl phosphate) (Biomonitoring California 2012). PIP (3:1) is used by industry as a flame retardant, plasticizer, anti-compressibility additive, anti-wear additive, or in some combination of these roles (U.S. Environmental Protection Agency (EPA) 2020b).

Depending on its composition, PIP (3:1) is associated with aquatic toxicity, and data suggests associations with neurotoxicity, reproductive and developmental toxicity, and systemic toxicity (U.S. Environmental Protection Agency (EPA) 2020b). Through the manufacturing, processing, and use of PIP (3:1), there may be releases of the chemical to air, land, and water. Table 2-3 presents the chemical structure and key characteristics of PIP (3:1).

Table 2-3: Chemical Name, Synonyms, and CAS RN for PIP (3:1)	
Chemical Name	Phenol, isopropylated, phosphate (3:1)
CAS RN	68937-41-7
Synonyms	PIP (3:1); PIP 3:1; iPPP; iPTPP; iPTPP; Tris (4-isopropylphenyl) phosphate; Isopropylated phenol phosphate (3:1); Isopropylated phenol phosphate; Isopropylphenyl phosphate; Isopropylated triphenyl phosphate; ITP; Phenol isopropylated phosphate; TIPPP
Molecular Formula <sup>1</sup>	Unspecified (UVCB substance) <sup>2</sup>
Representative Structure	 <p>Where R<sup>x</sup> = H or CH(CH<sub>3</sub>)<sub>2</sub> and all three rings have at least one -CH(CH<sub>3</sub>)<sub>2</sub> group.</p>
<p><b>Note(s):</b></p> <p><sup>1</sup>U.S. EPA's description of phenol, isopropylated, phosphate (3:1) lists C27H33O4P as the chemical formula for tri-propyl substitution although other sources including the National Medical Library have listed it as an UVCB (U.S. Environmental Protection Agency (EPA) 2015; U.S. National Library of Medicine (NLM) n.d.)</p> <p><sup>2</sup>Unknown of Variable Composition, Complex Reaction Products and Biological Materials.</p> <p><b>Sources:</b> European Chemicals Agency (ECHA) 2016c; National Toxicology Program (NTP) 2016; U.S. Environmental Protection Agency (EPA) 2017e; U.S. Environmental Protection Agency (EPA) 2024; U.S. National Library of Medicine (NLM) n.d.</p>	

PIP (3:1)'s assessment scores from the 2014 update of the *TSCA Work Plan for Chemical Assessments* (U.S. Environmental Protection Agency (EPA) 2014c) are summarized in Table 2-4. Possible scores range from 1 to 3, with 3 representing the most adverse score. While each chemical on the TSCA Work Plan for Chemical Assessments was given an exposure score, TSCA section 6(h)(1)(B) directs EPA to determine whether exposure to the PBT chemicals is likely under the conditions of use based on an exposure and use assessment. EPA has determined that, based on their *Exposure and Use Assessment of Five Persistent, Bioaccumulative and Toxic Chemicals* (U.S. Environmental Protection Agency (EPA) 2020b) and other reasonably available information, exposure to PIP (3:1) under the conditions of use is likely to the general population as well as in occupational contexts, to a potentially exposed or susceptible subpopulation, or the environment. EPA's determination is based on the opportunities for exposure throughout the lifecycle of PIP (3:1).

Table 2-4: Assessment Scores for PIP (3:1)				
Chemical Name	CAS RN	Hazard Score	Exposure Score	Persistence & Bioaccumulation Score
Phenol, isopropylated, phosphate (3:1) (PIP (3:1))	68937-41-7	3	3	3
<p><b>Note:</b> 3 = High, 2 = Moderate, 1 = Low.</p> <p><b>Source:</b> U.S. Environmental Protection Agency (EPA) 2014c</p>				

## 2.2 Regulatory Background

DecaBDE and PIP (3:1) are subject to various U.S. federal, state, and international regulations. This section summarizes existing regulation of the two chemicals.

## 2.2.1 Decabromodiphenyl ether (DecaBDE)

EPA published a rule on January 6, 2021 that affects decaBDE. Under Section 6(h) of TSCA, EPA's rule at 40 CFR 751.405 prohibits the manufacture and processing of decaBDE and decaBDE-containing products and articles<sup>5</sup> after March 8, 2021, and distribution in commerce of products and articles to which decaBDE has been added after January 6, 2022. Compliance dates or exclusions that are different include:

- By July 6, 2022 for any manufacture, processing and distribution in commerce of decaBDE for use in curtains in the hospitality industry, and of the curtains to which decaBDE has been added.
- By January 6, 2023 for any processing and distribution in commerce of decaBDE for use in decaBDE-containing wire and cable insulation, and the decaBDE-containing wire and cable insulation, in nuclear power generation facilities.
- By January 8, 2024 for manufacture, processing and distribution in commerce of decaBDE for use in parts installed in and sold as part of new aerospace vehicles, and of the parts to which decaBDE has been added for such vehicles. After the end of their service lives, import, processing, and distribution in commerce of aerospace vehicles that contain decaBDE in any part that are manufactured by January 8, 2024. After the end of their service lives manufacture, processing, and distribution in commerce of decaBDE for use in replacement parts for aerospace vehicles, and the replacement parts to which decaBDE has been added for such vehicles
- After the end of their service lives, or 2036, whichever is earlier, manufacture, processing and distribution in commerce of decaBDE for use in replacement parts for motor vehicles, and the replacement parts to which decaBDE has been added for such vehicles.
- After the end of their service lives, processing and distribution in commerce for plastic shipping pallets manufactured prior to March 8, 2021 that contain decaBDE.

Excluded from the prohibition is:

- Processing and distribution in commerce for recycling of decaBDE-containing plastic products and articles (i.e., the plastic to be recycled is from product and articles that were originally made with decaBDE), and for decaBDE-containing products or articles made from such recycled plastic, where no new decaBDE is added during the recycling or production process.

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<sup>5</sup> Article means a manufactured item (1) which is formed to a specific shape or design during manufacture, (2) which has end use function(s) dependent in whole or in part upon its shape or design during end use, and (3) which has either no change of chemical composition during its end use or only those changes of composition which have no commercial purpose separate from that of the article, and that result from a chemical reaction that occurs upon end use of other chemical substances, mixtures, or articles; except that fluids and particles are not considered articles regardless of shape or design.

Furthermore, manufacturers, processors, and distributors of decaBDE and articles to which decaBDE has been added are required to maintain ordinary business records, such as invoices and bills-of-lading, related to compliance with the prohibitions, restrictions, and other provisions of this rule. These records need to be maintained for a period of five years. These records must include a statement that the decaBDE-containing products or articles are in compliance with 40 CFR § 751.405(a). These records must be made available to EPA upon request. This recordkeeping requirement does not apply to the processing and distribution in commerce for recycling of plastic that contains decaBDE, and processing and distribution of those products and articles containing decaBDE from recycled plastic, and plastic shipping pallets, which are excluded from the rule.

In addition to these requirements, decaBDE is subject to various other U.S. federal, state, and international regulations. Other U.S. federal actions regarding the chemical are shown in Table 2-5.

**Table 2-5: Other Federal Policies Regarding DecaBDE**

Agency or Statute	Policy Name and Description
Toxic Substances Control Act (EPA)	One of the chemical substances required to be tested for dioxin/furan contamination (40 CFR part 766). Reportable under the TSCA 8(a) Chemical Data Reporting rule and health and safety data reporting required under TSCA 8(d) as outlined in 40 CFR part 716.
Emergency Planning and Community Right-to-Know Act (EPA)	DecaBDE has been on the Toxics Release Inventory (TRI) list of reportable chemicals since 1988 (53 FR 4500, February 16, 1988).
Agency for Toxic Substances and Disease Registry (ATSDR)	ATSDR established an acute-duration oral Minimum Risk Level (MRL) of 0.01 mg/kg/day for decaBDE and specific Target Organ Toxicity Doses (TTDs).

Many states have either enacted legislation of their own or adopted others' legislation. A list of the states with active legislation regarding brominated flame retardants can be found in Table 2-6.

**Table 2-6: State Policies for Controlling Flame Retardants (including DecaBDE and PIP (3:1))**

State	Policy Name and Description
Alaska	HB27: Bans the manufacture and sale of children's products containing chemical flame retardants, creates a system for identifying chemicals of high concern, and establishes participation in the Interstate Chemicals Clearinghouse.
	HB53: Bans the manufacture and sale of children's products and residential upholstered furniture containing chemical flame retardants.
California	AB 127: Requires the state fire marshal review flammability standards and chemical flame retardants, and propose updated insulation flammability standards that maintain both overall building safety and occupant/firefighter protection. (Adopted in 2013)
	SB 1019: Requires products to indicate if they contain added flame retardants, and make information available online. (Adopted in 2014)
	AB2998: Bans certain flame retardants (specifically including halogenated flame retardants) in children's products, mattresses, and upholstered furniture. This ban covers flame retardants at concentrations above 1,000 parts per million (ppm). (Adopted in 2018)
	TB 117: Outlines the required testing methods to determine the flame retardancy of various articles.
Connecticut	SB 255: Requires disclosure of flame retardants in consumer products. Beginning January 1, 2023, prohibits the sale of children's products containing flame retardants. (Status in Senate Committee)
Delaware	HB 77: Prohibits the manufacture, sale, or distribution of children's products, upholstered furniture used in residences, and mattresses that contain harmful flame retardant chemicals. (Effective in 2023)
Hawaii	HCR 235 / SR 107: Supports the industry phase-out of the flame retardant decaBDE and encourages the EPA to continue its efforts to end importation of decaBDE into the United States. (Adopted in 2010)

**Table 2-6: State Policies for Controlling Flame Retardants (including DecaBDE and PIP (3:1))**

State	Policy Name and Description
Illinois	HB 2572: Bans products containing more than one tenth of 1% of the flame retardants penta-BDE or octa-BDE. Directs the Illinois EPA to review the health impacts of and alternatives available to decaBDE and submit a report to the Governor. (Adopted in 2005)
Iowa	HF 457: Prohibits the manufacture and sale of bedding, carpeting, children's products, residential upholstered furniture, or window coverings containing toxic flame retardants.
Maine	LD182: Bans the sale of residential upholstered furniture containing chemical flame retardants in concentration greater than 0.1%. (Adopted in 2017)
	HB206: Prohibits the manufacture and sale of children's products and residential upholstered furniture containing chemical flame retardants.
	LD 1568: Prohibits the manufacture and sale of shipping pallets, or any product made from them, containing decaBDE. (Adopted in 2010)
	Executive Order: Creates a report assessing lead-free alternatives in consumer products, and one on alternatives to the flame retardant decaBDE. Establishes Governor's Task Force to Promote Safer Chemicals in Consumer Products. (Adopted in 2006)
	LD 1790: Bans products containing added brominated flame retardants. (Adopted in 2004)
Maryland	SB 556: Bans mattresses, residential upholstered furniture, and electronic equipment containing decaBDE by 2010. (Adopted in 2010)
	HB 83: Bans products containing the flame retardants penta- and octa-brominated diphenyl ether. Requires the Department of the Environment to report decaBDE in products, and make recommendations regarding the use, sale, and disposal of products containing it. (Adopted in 2005)
Massachusetts	S539: Prohibits the manufacture and sale of bedding, carpeting, children's products, residential upholstered furniture, and window treatment containing chemical flame retardants, and establishes a system to evaluate new flame retardants for toxicity.
Michigan	SB 1458: Authorizes the department to establish a committee to determine the risk posed by the release of toxic flame retardants PBDEs, other than penta-BDE or octa-BDE, to human health and the environment. (Adopted in 2004)
Minnesota	HF1627 / SF1535: Bans the manufacture and sale of children's products and residential upholstered furniture containing toxic flame retardants.
	SF 2096: Bans products containing the toxic flame retardants pentaBDE or octaBDE. Requires review of the flame retardant decaBDE, looking at safer alternatives, fire safety, and any evidence regarding the potential harm to public health and the environment. (Adopted in 2007)
	HF 1100 / SF 1215: Bans specified toxic flame retardants from children's products, mattresses, and residential upholstered furniture, specifies that not be replaced with chemicals that are carcinogens, endocrine disruptors, or otherwise cause developmental toxicity. (Adopted in 2015)
Mississippi	SB2816: Prohibits the manufacture and sale of children's products and residential upholstered furniture containing chemical flame retardants.
New Hampshire	SB193: Prohibits the manufacture and sale of upholstered furniture containing flame retardants in concentration greater than 0.1%. (Adopted in 2019)
New Jersey	A3885: Prohibits manufacture and sale of children's products and residential upholstered furniture containing toxic chemical flame retardants.
New Mexico	HB450 / SB453: Prohibits the manufacture and sale of children's products and residential upholstered furniture containing toxic chemical flame retardants
New York	S2718: Bans the sale of residential upholstered furniture containing chemical flame retardants. (Status: In Committee)
	A3368: Prohibits the sale and use of chemical flame retardants on residential upholstered furniture.
	S4465: Requires labelling of seasonal decorative lighting using lead as an additive flame retardant.

**Table 2-6: State Policies for Controlling Flame Retardants (including DecaBDE and PIP (3:1))**

State	Policy Name and Description
	S7621: Prohibits the use of flame retardants pentaBDE and octaBDE. Create a task force on flame retardant safety to review and report on relevant studies, risk assessments, findings, or rulings on decaBDE and its alternatives. (Adopted in 2004)
	S7737/A8723. Relates to the ban of the use of certain flame retardant chemicals in furniture and mattresses and in electronic casings (modifies the definition of "organohalogen flame retardant chemical" to specify that the chemical's functional use is to inhibit fire. (Effective in December 2024)
Oregon	SB 596: Phases the toxic flame retardant decaBDE from products bought and sold in the state. (Adopted in 2009)
	SB 962: Bans the toxic flame retardants pentaBDE and octaBDE, ands recommend banning decaBDE if safer alternatives are nationally available. (Adopted in 2005)
Rhode Island	H5082: Prohibits the manufacture and sale of children's products and residential upholstered bedding or furniture containing toxic flame retardants.
	HB 7917: Restricts the manufacturing or distribution of flame retardants containing pentaBDE or octaBDE, and requires study on decaBDE. (Adopted in 2006)
Tennessee	HB1029 / SB1049: Prohibits the manufacture and sale of children's products and residential upholstered furniture containing toxic flame retardants, sets limitations on their replacements, and requires disclosure of flame retardants used in all commercial upholstered furniture.
Vermont	H 444 / S 109: Bans the flame retardants octaBDE and pentaBDE from all products, and decaBDE from certain home products (mattresses and pads, residential furniture, televisions and computers). Prohibits a manufacturer from replacing decaBDE with a known or suspected carcinogen, or a chemical identified by the U.S. EPA as causing birth defects, hormone disruption, or harm to reproduction or development. (Adopted in 2009)
	S 81 / H 241: Bans the flame retardants octaBDE and pentaBDE from all products, bans the sale of mattresses and furniture with decaBDE. (Adopted in 2013)
Virginia	HB1861: Bans the manufacture and sale of children's products and residential upholstered furniture containing chemical flame retardants.
Washington	HB1596: Requires manufacturers of electronic products to disclose high priority chemicals used in said products.
	HB 1024: Bans the sale of certain products containing the flame retardants PBDEs and mattresses containing decaBDE and requires the state to study alternatives to them. Restricts the sale of televisions, computers, and residential upholstered furniture containing decaBDE as a result of the Departments' finding that safer and technically feasible alternatives that meet fire safety standards are available. (Adopted in 2007)
	Executive Order 04-01: Directs the Department of Ecology to move forward on phasing out the use of PBDEs. (Adopted in 2004)
Washington D.C.	B21-0143: Prohibits the manufacture, sale, or distribution of any children's product or residential upholstered furniture containing carcinogenic flame retardants or chemicals known to be carcinogenic to humans. (Adopted in 2016)
West Virginia	HB2121: Prohibits the manufacture and sale of children's products and residential upholstered furniture containing toxic chemical flame retardants and establishes rules for replacing those chemicals.
	HB2126: Prohibits the use of certain flame retardant chemicals (specifically including decaBDE) in children's products or upholstered residential furniture. (Status: House Introduced)

**Sources:**

The U.S. EPA's Design for the Environment (DfE) program released a final Alternatives Assessment for decaBDE in 2014. The assessment "provides detailed hazard information on 29 substances and mixtures

that have been identified as potentially viable alternatives to decaBDE in a variety of polymers and applications" (U.S. Environmental Protection Agency (EPA) 2014a).<sup>6</sup>

The Voluntary Emissions Control Action Programme (VECAP) is a voluntary initiative of the European Brominated Flame Retardant Industry Panel to reduce uncontrolled decaBDE emissions from manufacturing processes. The program was initiated in 2004 by the UK Textile Finishers Association. In recent years it has expanded to include the European textiles and plastics industry and has been introduced in North America (2006), Mexico, China, Japan, Singapore, Thailand, Indonesia, South Korea and Taiwan. VECAP is characterized by a 6-step cycle to promote chemical management and environmental stewardship, which includes a commitment to the VECAP principles in work procedures and operations, a self-audit, a mass balance approach, a baseline emissions survey, an emissions improvement plan, and implementation and continuous improvement. There was an increase of VECAP participation of decaBDE users in North America by 40% from 2011 to 2012 (Voluntary Emissions Control Action Programme (VECAP) 2012).

In Canada, the Prohibition of Certain Toxic Substances Regulations were amended on October 23, 2016 to include all polybrominated diphenyl ethers (PBDEs), including decaBDE, among the prohibited toxic substances for Canada. This regulation prohibits the import, manufacture, use, sale, and offer for sale of PBDEs and products containing PBDEs unless present in a manufactured article, effective on December 23, 2016 (Environment and Climate Change Canada 2016).

In February 2017, the European Union published a restriction under their Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH) regulation for decaBDE. The restrictions are as follows:

- DecaBDE will not be manufactured or placed on the market as a substance on its own after March 2, 2019
- DecaBDE in a concentration equal to or greater than 0.1% by weight will not be used on the production of, or placed on the market in another substance, as a constituent; a mixture; or an article, or any part thereof
- Exemptions include use in:
  - The production of aircraft before March 2, 2027
  - The production of spare parts for aircraft produced before March 2, 2027 or motor vehicles, agricultural and forestry vehicles, or machinery produced before March 2, 2019.
  - Articles placed on the market before March 2, 2019
  - Certain electrical or electrical equipment (European Chemicals Agency (ECHA) n.d.)

On November 29, 2017, Japan proposed restrictions on the import of products containing decaBDE. The prohibited decaBDE-containing products include: textiles, adhesives and sealing fillers, floor coverings, curtains, banner flags, and any chemicals for flame retardant treatment for textiles, resin and rubber (Chemical Safety Office et al. 2017). There does not appear to be any restriction on domestic manufacture of decaBDE in Japan, and no other restrictions or regulations for other Asian countries were found.

On June 20, 2019, decaBDE was listed in Annex I of Regulation (EU) 2019/1021 of the European Parliament and the Council of the European Union on Persistent Organic Pollutants (POP Regulation). Under this regulation, the manufacturing, placing on the market and use of decaBDE, whether on its own, in mixtures, or in articles, is prohibited (European Union (EU) 2019). On October 28, 2021, the European Commission proposed new concentration limits for PBDEs including decaBDE in waste as a revision to

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<sup>6</sup> U.S. Environmental Protection Agency (EPA), 2014. An Alternatives Assessment for the Flame Retardant Decabromodiphenyl Ether (DecaBDE). [https://www.epa.gov/sites/default/files/2014-05/documents/decabde\\_final.pdf](https://www.epa.gov/sites/default/files/2014-05/documents/decabde_final.pdf).

Annexes IV and V to Regulation (EU) 2019/1021 on Persistent Organic Pollutants. The new limits aim to reduce concentrations in waste from 1000 mg/kg to 500 mg/kg. A draft report of these thresholds was published by the EP rapporteur on February 9, 2022. On November 23, 2022, Annexes IV and V were amended to reduce the sum of concentrations limits for decaBDE and other PBDEs. Concentration limits would be reduced from 500 mg/kg to 350 mg/kg beginning on December 30, 2025, and 200 mg/kg beginning December 30, 2027 (European Union (EU) 2019). The sum of concentration limits to be reduced includes Tetra-, Penta-, Hexa-, Hepta-, and DecaBDE. There is also a 10 mg/kg unintentional trace contaminant concentration for decaBDE, defined as equal to or below 10 mg/kg (0.001% by weight), set forth in ANNEX I.

In October 2019, the Chemical Review Committee (CRC-15) of the Rotterdam Convention on the Prior Informed Consent (PIC) Procedure for Certain Hazardous Chemicals and Pesticides in International Trade recommended that decaBDE be made subject to the PIC procedure (Wagner 2019).

DecaBDE is also listed as a persistent organic pollutant (POP) under the Stockholm Convention, which requires parties to take measures to eliminate production and use of the chemical.

Table 2-7 summarizes these policies.

<b>Table 2-7: International Policies regarding DecaBDE</b>	
<b>Source</b>	<b>Policy Name and Description</b>
Voluntary Emissions Control Action Programme (VECAP)	VECAP is characterized by a 6-step cycle to promote chemical management and environmental stewardship, which includes a commitment to the VECAP principles in work procedures and operations, a self-audit, a mass balance approach, a baseline emissions survey, an emissions improvement plan, and implementation and continuous improvement (Voluntary Emissions Control Action Programme (VECAP) 2016). There was an increase of VECAP participation of decaBDE users in North America by 40% from 2011 to 2012 (Voluntary Emissions Control Action Programme (VECAP) 2012).
Canada	Prohibition of Certain Toxic Substances Regulations were amended on October 23, 2016 to include all polybrominated diphenyl ethers (PBDEs), including decaBDE.
European Union	Under the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH), published a regulation for decaBDE in February 2017. The regulation included a prohibition and a concentration limit with numerous exemptions.
European Union	DecaBDE listed in Annex I of Regulation (EU) 2019/1021 of the European Parliament and the Council of the European Union on Persistent Organic Pollutants (POP Regulation).
Japan	Proposed restrictions on the import of products containing decaBDE, including: textiles, adhesives and sealing fillers, floor coverings, curtains, banner flags, and any chemicals for flame retardant treatment for textiles, resin and rubber.
Rotterdam Convention	The Chemical Review Committee (CRC-15) of the Rotterdam Convention on the Prior Informed Consent (PIC) Procedure for Certain Hazardous Chemicals and Pesticides in International Trade recommended that decaBDE be made subject to the PIC procedure.
Stockholm Convention	HCR 235 / SR 107: Supports the industry phase-out of the flame retardant decaBDE and encourages the EPA to continue its efforts to end importation of decaBDE into the United States. (Adopted in 2010)

## 2.2.2 Phenol, isopropylated, phosphate (3:1) (PIP (3:1))

EPA published a rule on January 6, 2021 that affects PIP (3:1). Under Section 6(h) of TSCA (promulgated at 40 CFR 751.407), after March 8, 2021 the processing and distribution in commerce for use of PIP (3:1) or PIP (3:1)-containing products or articles is prohibited, with exceptions for the processing and distribution for use in commerce of PIP (3:1) and PIP (3:1)-containing products for use in:

- Adhesives or sealants, PIP (3:1)-containing products for use in adhesives and sealants and PIP (3:1)-containing adhesives and sealants, until January 6, 2025;
- PIP (3:1)-containing photographic printing articles, and PIP (3:1)-containing photographic printing articles, until January 1, 2022;
- Hydraulic fluids either for the aerospace industry or to meet military specifications for safety and performance where no alternative chemical is available that meets U.S. Department of Defense specification requirements, PIP (3:1)-containing products for use in such hydraulic fluids, and PIP (3:1)-containing hydraulic fluids either for the aerospace industry or to meet military specifications for safety and performance where no alternative chemical is available that meets U.S. Department of Defense specification requirements;
- Lubricants and greases, PIP (3:1) containing products for use in lubricants and greases; and PIP (3:1)-containing lubricants and greases;
- New and replacement parts for motor and aerospace vehicles, the new and replacement parts to which PIP (3:1) has been added for such vehicles, and the motor and aerospace vehicles that contain new and replacement parts to which PIP (3:1) has been added;
- Use as an intermediate in a closed system to produce cyanoacrylate adhesives;
- Specialized engine filters for locomotive and marine applications, PIP (3:1) containing products for use in specialized engine air filters for locomotive and marine applications, and PIP (3:1)-containing specialized engine air filters for locomotive and marine applications;
- Plastic for recycling from products or articles containing PIP (3:1), where no new PIP (3:1) is added during the recycling process;
- Finished products and articles made of plastic recycled from products or articles containing PIP (3:1), where no new PIP (3:1) was added during the production of the products or articles made of recycled plastic.

EPA also prohibited releases to water from the ongoing processing, distribution in commerce, and commercial use activities that are permitted to occur as outlined in the preceding bullets. All persons are required to follow all applicable regulations and best management practices for preventing the release of PIP (3:1) and PIP (3:1)-containing product to water during commercial use. Furthermore, processors and distributors of PIP (3:1) and products containing PIP (3:1) in commerce are required to notify their customers of these prohibitions on processing and distribution, and the prohibition on releases, via safety data sheet (SDS) or labeling. In addition, each person who continues to manufacture, process, or distribute in commerce PIP (3:1) or PIP (3:1)-containing products or articles must maintain ordinary business records—such as invoices and bills-of-lading—related to compliance with the prohibitions, restrictions, and other provisions of the rule. These records must be maintained for a period of three years from the date the record is generated. These records also must include a statement that the PIP (3:1), or the PIP (3:1)-containing products or articles, are in compliance with 40 CFR § 751.407(a). Upon request, these records must be made available to EPA. This recordkeeping requirement does not apply to the processing and distribution in commerce for recycling of plastic that contains PIP (3:1), and processing and distribution of those products and articles containing PIP (3:1) from recycled plastic, that are excluded from the rule.

In September 2021, EPA extended the compliance date applicable to the processing and distribution in commerce of certain PIP (3:1)-containing articles, and the PIP (3:1) used to make those articles from March 8, 2021, to March 8, 2022. In March 2022, EPA further extended the compliance date applicable to the prohibition on processing and distribution in commerce of certain PIP (3:1)-containing articles, and the PIP (3:1) used to make those articles, until October 31, 2024, along with the compliance date for the associated recordkeeping requirements for manufacturers, processors, and distributors of PIP (3:1)-containing articles.

Prior to the January 2021 final rule, no federal action was taken to restrict the use of PIP (3:1). Other federal actions related to PIP (3:1) are listed in Table 2-8.

**Table 2-8: Other Federal Policies Regarding PIP (3:1)**

Agency or Statute	Policy Name and Description
Toxic Substances Control Act (EPA)	Added to the Priority Testing List by the TSCA Interagency Testing Committee in May 2012 (77 FR 30855).
Resource Conservation and Recovery Act (EPA)	When discarded, aviation and industrial hydraulic fluid and lubricants and greases are subject to RCRA guidelines for managing used oil (40 CFR part 279).

PIP (3:1) functions as a phosphorus-based flame retardant. A number of states have rules regulating chemical flame retardants. A list of the states with active legislation regarding chemical flame retardants can be found in Table 2-6 in Section 2.2.1.

PIP (3:1) is a component in the flame-retardant product Firemaster® 550, developed by the firm Chemtura and introduced in 2004 as an alternate to pentaBDE, which was phased out by agreements between industry and EPA (Dodson et al. 2012). Following the phase-out of pentaBDE, Firemaster® 550 and Tris (1,3-dichloroisopropyl) phosphate (TDCPP) were used to comply with a 1975 California furniture flammability standard called Technical Bulletin 117 (TB117) (Blum et al. 2012). The replacement standard, TB-117-2013, took effect in January 2014 and no longer necessitates the use of chemical flame retardants to meet fire safety standards.

PIP (3:1) was added to Washington State Department of Ecology's list of chemicals of high concern to children (CHCCs) in 2017, but manufacturers were not obligated to report it until January 31, 2019 (Washington State Department of Ecology 2018).

No international regulations were identified that restrict the use of PIP (3:1). However, the chemical is under assessment as Persistent, Bioaccumulative and Toxic under REACH, as of 2020, (European Union (EU) 2022) and under risk evaluation under the Canadian Environmental Protection Act.

## **2.3 Justification for Risk Management Action for DecaBDE and PIP (3:1)**

This section provides legal and economic justification of the rule to regulate decaBDE and PIP (3:1) in the United States at the federal level of government. Section 2.3.1 indicates the statutory authority for EPA to take risk management action, Section 2.3.2 identifies market failure in the industries where decaBDE and PIP (3:1) is used, Section 2.3.3 discusses regulatory remedies to address market failure from negative externalities, and Section 2.3.4 provides justification for regulation at the federal level specifically.

### 2.3.1 Statutory Authority

TSCA section 6(h), 15 U.S.C. 2601 *et seq.*, directs EPA to take expedited action to complete TSCA section 6(a) rules on certain PBT chemical substances. EPA must apply one or more of the requirements listed in TSCA section 6(a) to the extent necessary to meet the TSCA section 6(h)(4) statutory standard. More specifically, EPA must take action on those chemical substances identified in the 2014 Update to the TSCA Work Plan for Chemical Assessments (U.S. Environmental Protection Agency (EPA) 2014c) that, among other factors, EPA has a reasonable basis to conclude are toxic and that with respect to persistence and bioaccumulation score high for one and either high or moderate for the other, pursuant to the TSCA Work Plan Chemicals: Methods Document (U.S. Environmental Protection Agency (EPA) 2012).

In response to this directive, in January 2021, EPA promulgated five rules to regulate the following five PBT chemical substances: DecaBDE; PIP (3:1); 2,4,6-TTBP (CASRN 732-26-3); HCBD (CASRN 87-68-3); and PCTP (CASRN 133-49-3) (Refs. 3, 4, 5, 6, and 7). With the obligation to promulgate these rules, the Agency also has the authority to amend them (e.g., if circumstances change, including in relation to the receipt of new information). It is well settled that EPA has inherent authority to reconsider, revise, or repeal past decisions to the extent permitted by law so long as the Agency provides a reasoned explanation. See *F.C.C. v. Fox Television Stations, Inc.*, 556 U.S. 502, 515 (2009). Based on information submitted by regulated entities since the publication of the 2021 decaBDE and PIP (3:1) final rules, the Agency has determined that amendments to both rules are necessary to address implementation issues and to further reduce exposure to these chemical substances to the extent practicable.

### 2.3.2 Market Failure

The private market is a mechanism that can allocate resources efficiently. However, the market's allocation of resources will not always be desirable from the standpoint of society. The market will fail to achieve a socially efficient outcome when differences exist between private market values and social values.

Welfare economics states that a socially efficient outcome is achieved if no alternative allocation of society's resources can make at least one person better off without making another one worse off. This is referred to as a Pareto optimal outcome. If the private market fails to achieve this efficient outcome, too little or too much is produced, resulting in a loss in economic welfare. This is referred to as a market failure.

However, Pareto optimality is a strict condition and can allow for very unequal allocations. It does not address redistributive actions, in which one group is made worse off and another group is made better off. A less strict criteria for measuring economic improvement is Kaldor-Hicks efficiency. Under this criterion, economic efficiency is improved if those who benefit from an action gain more than those who lose from that action.<sup>7</sup> This is the fundamental efficiency criterion of benefit-cost analysis: society is

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<sup>7</sup> The Kaldor-Hicks criterion is also referred to as the potential Pareto criterion or the potential compensation principle because it implies that economic efficiency is improved if those who benefit from an action could fully compensate those who lose from that action, and still be better off. In other words, it is theoretically possible to achieve a Pareto improvement – in which some are made better off, and no one is made worse off – if those who benefit from a regulation were to fully compensate those who pay the cost. The word “potential” is used because the compensation does not have to actually occur, it just has to be theoretically possible to do so for this to be a social improvement.

considered to be better off (in terms of economic efficiency) if the benefits of an action outweigh the cost of undertaking it.

Government regulation of a private market is justified when the market fails to deliver a socially efficient outcome. If a regulation can produce benefits that exceeds its cost, then economic efficiency has been improved. The economic literature has identified the following common causes of market failure and economic inefficiency:

- Existence of externalities (negative and positive);
- Under-provision of common property resources, and public goods;
- Market power (e.g., monopolies);
- Inadequate or asymmetric information

This section discusses how negative externalities are present in the market for the chemical regulated under this rule<sup>8</sup>. By understanding how the market is affected by this market failure, more effective regulations can be designed.

### **Externalities**

A negative externality occurs when one party's action imposes an uncompensated negative effect on another party. For example, the manufacturer, processor, or consumer of a good may impose costs on another party if the good causes an adverse health impact that is not known or factored into the market transaction. Since these external costs are not internalized by the manufacturer, processor, or user, they are not considered in the production (or processing, use) and pricing decisions. As a result, the societal cost of these goods is under-valued and the level of output produced (or processed, used) is higher than the social optimal output level. In other words, a negative externality occurs when a firm makes decisions based on private costs instead of social costs, leading to an excess of product in the market.

EPA believes that the cause of market failure in the market for decaBDE and PIP (3:1) subject to this final rule stems from negative externalities. The releases and exposure to decaBDE and PIP (3:1) that may impose health and environmental costs on third parties are not internalized by those manufacturing, processing, distributing, or using the chemical. Negative externalities are exacerbated by the persistence and bioaccumulation of this chemical, which causes it to linger in the environment and exert toxic effects on human health and/or the environment over an extended period. By reducing the volume through prohibition or by reducing the exposure through use of PPE of decaBDE and PIP (3:1) in the market, the negative externalities caused by exposure to these chemicals are reduced, thereby resulting in an improvement in welfare.

Society will experience health benefits from regulatory measures that limit or eliminate the manufacture, processing and use or limit exposure due to PPE of decaBDE and PIP (3:1). However, society will experience *net benefits* from these regulatory measures only up to the point where the benefits of reducing these negative externalities are less than the costs of achieving them. If the costs of these regulatory measures on manufacturers and users of decaBDE and PIP (3:1) are greater than the external costs imposed by their use, the regulation is too strict and the new state is also suboptimal. Social welfare would be decreased by any regulatory measure that goes beyond the point where the volume of methylene

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<sup>8</sup>This discussion focuses on negative externalities because this is the market failure addressed by this proposed regulation. Please refer to EPA Guidelines for Preparing Economic Analyses (EPA 2014b) for a discussion on additional sources of market failure identified in the literature.

chloride has been reduced to the same point as if the externalities were internalized. The economically efficient level of control is where the additional (marginal) cost of further control equals society's willingness to pay for the next increment of control. Adverse effects may still occur at this level, but additional regulatory costs to further reduce or eliminate these effects would not be Pareto optimal. Conversely, if post-rule, the cost to society from release and exposure to methylene chloride remains greater than costs to regulated firms, the rule would also not produce a Pareto optimal outcome.

### **2.3.3 Remedies to Reduce Negative Externalities**

As discussed below in Section 2.4, the final rule regulatory option and alternative options detail various requirements that will reduce the negative human health costs associated with the negative externality. EPA contends that these measures are sufficient to reduce negative externalities associated with decaBDE and PIP (3:1).

### **2.3.4 Justification for Regulation at the Federal Level**

The chemicals and products associated with this rulemaking are distributed in commerce across state lines, and thus they fall under the federal jurisdiction of regulation under TSCA. It is more efficient for companies manufacturing, processing, and distributing these products to comply with a single federal standard rather than a patchwork of different state regulations. While this rule will not preempt state standards, states would not need to promulgate regulations if there is a federal regulation in place.

## **2.4 Regulatory Options and Alternative Regulatory Approaches**

Section 6 of TSCA, as amended by the Frank R. Lautenberg Chemical Safety for the 21st Century Act, provides EPA with the authority to prohibit or limit the manufacture, processing, distribution in commerce, use, or disposal of a chemical if EPA evaluates the risk and concludes that the chemical presents an unreasonable risk to human health or the environment.

Under Section 6(a), the law authorizes EPA to issue regulations requiring one or more of the following actions to the extent necessary so that the chemical substance no longer presents an unreasonable risk:

- Prohibit or otherwise restrict manufacture, processing, or distribution in commerce (§6(a)(1));
- Prohibit or otherwise restrict for a particular use or above a set concentration (§6(a)(2));
- Require minimum warnings and instructions with respect to use, distribution in commerce, or disposal (§6(a)(3));
- Require recordkeeping or testing (§6(a)(4));
- Prohibit or regulate any manner or method of commercial use (§6(a)(5));
- Prohibit or regulate any manner or method of disposal (§6(a)(6)); and/or
- Direct manufacturers or processors to give notice of the unreasonable risk to distributors and replace or repurchase products if required (§6(a)(7)).

The following subsections describe the risk management options that EPA has chosen for current uses of decaBDE and PIP (3:1).

#### **2.4.1 Regulatory Remedies to Reduce Negative Externalities**

According to the 2014 update of the *TSCA Work Plan for Chemical Assessments*, decaBDE and PIP (3:1) have high persistence and high potential for bioaccumulation (U.S. Environmental Protection Agency (EPA) 2014c). The general population, commercial and consumer end-users, other vulnerable subpopulations (workers, children, Tribes) and the environment may be exposed and, if so, negatively affected. EPA is finalizing measures that reduce the amount of decaBDE and PIP (3:1) in the market or limit exposure to these chemicals. For decaBDE, the final rule requires the use of PPE during manufacturing or processing of certain products containing decaBDE. For PIP (3:1), the rule prohibits the manufacture for certain uses (including import), after specified periods of time, and requires PPE use for the manufacturing and processing of products and articles that contain PIP (3:1).

The final regulatory action will reduce the negative externalities for workers associated with both chemicals. As processing and distribution is generally prohibited unless otherwise excluded, the regulation also eliminates the negative externalities associated with the exposure generally, including by consumers.

In the absence of a risk evaluation with quantified risk estimates, this analysis does not quantify the benefits of the regulatory options.<sup>9</sup>

#### **2.4.2 Decabromodiphenyl ether (DecaBDE)**

The regulatory amendments that for decaBDE under this rulemaking, as well as the primary alternative option, are summarized in Table 2-9, and described in the sections below.

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<sup>9</sup> Marginal changes in risk are needed to estimate/quantify welfare changes.

**Table 2-9: Summary of Final DecaBDE Risk Management Options**

Chemical Use	Final Option <sup>1</sup>	Primary Alternative Option
Distribution in commerce of decaBDE-containing plastic shipping pallets manufactured before March 8, 2021; and, Processing and distribution in commerce for recycling of decaBDE-containing plastic from products or articles and decaBDE-containing products or articles made from such recycled plastic, where no new decaBDE is added during the recycling process	Require signage providing notice to workers that PPE is required to be worn during the recycling of plastic shipping pallets, which will reduce potential exposures to decaBDE. Require inhalation and dermal PPE (N95 mask and chemical-resistant gloves) during the recycling process of shipping pallets known to contain decaBDE.	Require a label on all recycled plastic articles containing decaBDE. Require inhalation and dermal PPE (e.g., N95 mask, chemical-resistant gloves) during all recycling processes of plastics.
Manufacture and processing of decaBDE for use in replacement parts and the manufacture of such parts, specifically use in parts installed in and distributed as part of new aerospace vehicles, and the manufacturing and processing of parts to which decaBDE has been added for such vehicles.	Require inhalation and dermal PPE (N95 mask and chemical-resistant gloves), except for the processing of parts to which decaBDE has been added.	No changes from 2021 Final Rule
Manufacture and processing of decaBDE for use in replacement parts and the manufacture of such parts, specifically decaBDE and decaBDE-containing products for use in replacement parts for motor vehicles, and the manufacturing and processing of replacement parts to which decaBDE has been added for such vehicles.	Require inhalation and dermal PPE (N95 mask and chemical-resistant gloves), except for the processing of parts to which decaBDE has been added	No changes from 2021 Final Rule
Releases of decaBDE to water	Prohibit the releases to water during manufacturing, processing, distribution in commerce of decaBDE, decaBDE-containing products, and all persons are required to follow all applicable regulations for preventing the release of decaBDE.	No changes from 2021 Final Rule
Processing and distribution in commerce of decaBDE for use in wire and cable insulation in nuclear power generation facilities	After the end of the wire and cables' service life, all persons are prohibited from all processing and distribution in commerce of decaBDE-containing wire and cable insulation for use in wire and cable insulation in nuclear power generation facilities (including research and test reactors).  Require export notification for all persons intending to export decaBDE-containing wire and cable insulation for nuclear power generation facilities.	No changes from 2021 Final Rule

<sup>1</sup> In response to public comments on the NPRM, the final rule also establishes a regulatory threshold level. This amendment in § 751.405 (a) prohibits all manufacturing and processing of decaBDE or decaBDE-containing products or articles after March 8, 2021, and prohibits all distribution in commerce of decaBDE or decaBDE-containing products or articles after January 6, 2022, unless decaBDE concentrations are at or below 0.1% by weight, not including any amount present due to excluded uses, including recycling or phased-out uses.

### Final Amendments – DecaBDE

This final rule addresses public comments received on the NPRM requesting that EPA establish a regulatory threshold level for quantities of PIP (3:1) and decaBDE in products and articles. The final rule

sets a threshold level of 0.1 percent for both decaBDE and PIP (3:1). Using this threshold concentration, the bans on manufacturing, processing, and distributing in commerce products and articles only apply to products and articles containing more than 0.1 percent decaBDE by weight or 0.1 percent PIP (3:1) by weight, not counting decaBDE or PIP (3:1) in products or articles that are excluded from the bans or for which the delayed bans have not reached their compliance date.

For all uses, except as noted below, the final rule establishes a regulatory threshold level such that: all persons are prohibited from all manufacturing and processing of decaBDE or decaBDE-containing products or articles after March 8, 2021, and all persons are prohibited from all distribution in commerce of decaBDE or decaBDE-containing products or articles after January 6, 2022, unless decaBDE concentrations are at or below 0.1 percent by weight.

**Worker protection (PPE) requirements.** To ensure minimal potential for exposure to workers during domestic manufacturing and processing, the owner or operator must demarcate regulated areas<sup>10</sup> from the rest of the workplace in a manner that adequately establishes and alerts persons to the boundaries of the regulated area and minimizes the number of authorized persons exposed to decaBDE within the regulated area in where activities involving decaBDE—specifically manufacture and processing of decaBDE for use in replacement parts and the manufacture of such parts and processing through recycling of pallets—occur. The final rule also requires certain PPE requirements to address potential respiratory and dermal exposure to occupational workers during permitted ongoing domestic manufacturing or processing activities involving decaBDE. EPA requires respiratory and dermal PPE for manufacturing and processing of decaBDE and decaBDE-containing products and articles with exclusions. This will affect the recycling process of decaBDE-containing plastic shipping pallets and the manufacturing and processing of decaBDE for aerospace and auto replacement parts. EPA is not requiring respiratory and dermal PPE during the recycling of any other products or articles that might contain decaBDE. EPA is not requiring PPE for processing of decaBDE-containing wire and cable for use in nuclear power generation facilities or decaBDE-containing parts where the decaBDE has already been added. EPA is not requiring PPE for distribution in commerce of decaBDE-containing articles, since the processing and distribution in commerce of these decaBDE containing articles would result in minimal potential for worker exposure (U.S. Environmental Protection Agency (EPA) 2020b).

For the activities subject to this final rule, EPA is requiring, at a minimum, a respirator at least as protective as a NIOSH-approved air-purifying filtering facepiece/dust mask respirator with an assigned protection factor (APF) of 10, commonly referred to as an N95 mask, and gloves that are chemically resistant to decaBDE with activity-specific training where dermal contact with decaBDE is possible. For respirators with an APF 10, EPA is requiring that the owner or operator must ensure that all respirators used in the workplace are NIOSH-approved as listed on the NIOSH Certified Equipment List (NIOSH 2023). In choosing appropriate gloves, EPA is requiring that owners and operators consider effectiveness of glove type when preventing exposures from decaBDE alone and in likely combination with other chemical substances used in the work area, degree of dexterity required to perform tasks, and temperature, as identified in the Hand Protection section of OSHA's Personal Protective Equipment guidance (Occupational Safety and Health Administration (OSHA) 2004). EPA is requiring owners and operators in these domestic manufacturing and processing activities to provide and require wearing of the specified PPE to persons potentially exposed to decaBDE.

EPA is finalizing the requirement for implementation of a PPE program in alignment with certain elements of OSHA's General Requirements for PPE at 29 CFR 1910.132 and Respiratory Protection

<sup>10</sup> As defined in 40 CFR 751.403 d

requirements in 29 CFR 1910.134.<sup>11</sup> Owners and operators are required to provide PPE that is of safe design and construction for the work to be performed. EPA is requiring that owners and operators maintain PPE in a sanitary, reliable, and undamaged condition and ensure that each potentially exposed person who is required to wear PPE uses such PPE. EPA is requiring owners and operators ensure each potentially exposed person who is required to wear PPE to use and maintain PPE in a sanitary, reliable, and undamaged condition. Owners and operators are required to select and provide PPE that properly fits each potentially exposed person who is required to use PPE and communicate PPE selections to each affected person.

EPA is also finalizing its proposal to require each owner/operator to comply with OSHA's respiratory protection training requirements at 29 CFR 1910.134(k) and general PPE training requirements at 29 CFR 1910.132(f) when using respirators and gloves. EPA is requiring that owners and operators provide PPE training to each potentially exposed person who is required to wear PPE prior to or at the time of initial assignment to a job involving potential exposure to decaBDE.

EPA is also requiring implementation of a respiratory protection program in alignment with certain elements of 29 CFR 1910.134, which requires each owner or operator to select respiratory protection in accordance with the guidelines for proper respirator use, maintenance, fit-testing, medical evaluation, and training. EPA is also requiring that owners or operators who are required to administer a respiratory protection program must ensure that when a respirator utilized, it complies with 29 CFR 1910.134(d)(1)(iv). The employer must ensure that all potentially exposed persons within the regulated area are using the provided respirators whenever exposures to airborne concentrations of decaBDE can reasonably be expected and are not already controlled by one or a combination of elimination, substitution, engineering controls, or administrative controls to reduce exposure to the extent practicable.

EPA requires that owners and operators document respiratory protection used and PPE program implementation. EPA requires that owners and operators document in the PPE program the following information, as applicable, and are available to EPA upon request:

- (A) The name, workplace address, work shift, job classification, and work area of each person reasonably likely to directly handle decaBDE or handle equipment or materials on which decaBDE may be present and the type of PPE selected to be worn by each of these persons;
- (B) The basis for PPE selection (e.g., demonstration based on permeation testing or manufacturer specifications that each item of PPE selected provides an impervious barrier to prevent exposure

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<sup>11</sup> As discussed in the FRN for this final rule, EPA also considered the National Institute for Occupational Safety and Health (NIOSH) hierarchy of controls. In order of precedence, this hierarchy of controls includes elimination of the hazard, substitution with a less hazardous substance, engineering controls, administrative controls (e.g., training or exclusion zones with warning signs), and, finally, use of PPE (Ref. 23 of FRN). Under the hierarchy of controls, the use of respirators should only be considered after all other measures have been taken to reduce exposures, and then under the context of the OSHA Respiratory Protection Standard at 29 CFR 1910.134. Under OSHA's standards, the various exposure controls are prioritized equally, followed by PPE requirements when necessary. When formulating the proposed worker protection requirements on the limited time allotted for the TSCA section 6(h) rulemakings, no risk evaluation or assessment was required or feasible and an already existing risk assessment was not available to support calculation of safe exposure levels for these two chemicals, which would be necessary for EPA to establish a workplace chemical protection program. Thus, EPA is finalizing specific engineering controls and PPE for one industry sector, specifically the use of PIP (3:1) as an intermediate in cyanoacrylate adhesives in which the Agency had additional information about existing practice.

during expected duration and conditions of exposure, including the likely combinations of chemical substances to which the PPE may be exposed in the work area); and

(C) Appropriately sized PPE and training on proper application, wear, and removal of PPE, and proper care/disposal of PPE.

EPA is requiring each owner or operator supply PPE to each potentially exposed person within 60 days after publication of the final rule.

**Plastic shipping pallets.** EPA's 2023 NPRM proposed a labeling requirement for decaBDE-containing plastic shipping pallets. The purpose of EPA's proposed label was to provide notice that PPE is required during the recycling of plastic shipping pallets. However, since exposure to decaBDE in plastic shipping pallets that are in use and moving throughout commerce is not expected (U.S. Environmental Protection Agency (EPA) 2020b), and after considering public comments received on the proposal, EPA is not finalizing the labeling requirement for plastic shipping pallets.

To reduce potential exposures to decaBDE during the recycling of decaBDE-containing plastic shipping pallets, EPA is finalizing a signage requirement in the regulated area, defined at 40 CFR 751.403 as "an area established by the regulated entity to demarcate areas where airborne concentrations of a specific chemical substance can reasonably be expected." This definition is intended to include those areas where plastic pallets are recycled. This sign will provide notice to workers that PPE is required to be worn during recycling of plastic shipping pallets manufactured before March 8, 2021, which will reduce potential exposures to decaBDE (see Unit III.C.2. for more information on specific PPE requirements). A sign must be posted at every entry point into the regulated area that clearly, prominently, in multiple languages as appropriate, and in an easily readable font size, contains the following text:

"Decabromodiphenyl ether (decaBDE) (CASRN 1163-19-5), a chemical that has been identified as a persistent, bioaccumulative, and toxic (PBT) chemical by the U.S. Environmental Protection Agency, may be present in this regulated area. All persons in this regulated area who recycle plastic shipping pallets manufactured before March 8, 2021 are required to wear personal protective equipment, including respiratory protection that is at least as protective as a NIOSH-approved N95 respirator with an assigned protection factor (APF) of 10 and dermal protection of gloves that are chemically resistant to decaBDE, per regulations at 40 CFR 751.405(e). EPA is not requiring testing to determine if decaBDE is present in the plastic shipping pallets.

**Releases of DecaBDE to water.** EPA is prohibiting the releases to water during the manufacturing, processing, and distribution in commerce of decaBDE, decaBDE-containing products, and all persons are required to follow any applicable regulations that may apply or preventing the release of decaBDE to water.

Prohibiting releases to water highlights the importance of reducing environmental releases of chemicals regulated by TSCA section 6(h) and reduces exposures that could occur. Despite the decreasing reporting trends of decaBDE, prohibiting releases to water during manufacture, processing, and distribution in commerce of decaBDE will prevent any future releases of decaBDE to water from any excluded uses under both the 2021 final decaBDE rule and this rule, overall reducing the potential for exposures.

Taking into account the comments received and this approach to ensure future activities are prohibited, EPA is prohibiting releases to water for from the manufacture, processing, and distribution in commerce of decaBDE from uses that are permitted to occur. EPA is not extending this restriction to include a ban on the release to water for articles, including recycled materials, that may contain decaBDE.

**Wire and cable in nuclear power generation facilities.** EPA is extending the compliance date, limited to processing and distribution in commerce of decaBDE-containing wire and cables in nuclear power plants,

until after the end of the service life of the wire and cable and the components containing the wire and cable. Stakeholders have indicated that existing decaBDE-containing wire and cable may need to be distributed and processed for refurbishment, maintenance, and repair until the wire and cable is replaced. In addition, EPA's "Exposure and Use Assessment of Five Persistent, Bioaccumulative, and Toxic Chemicals" notes that releases of decaBDE could occur during the processing of decaBDE to make the wire and cable. However, once formulated, decaBDE is encased in the cured coating and the potential for worker exposure is minimal. Therefore, EPA believes allowing this is necessary and practicable while being protective of potential exposure of decaBDE.

EPA is not allowing resumption of processing and distribution in commerce of raw or compounded decaBDE for use in wire and cable insulation in nuclear power generation facilities.

DecaBDE is listed on Annex A of the Stockholm Convention on Persistent Organic Pollutants (the POPs Convention), which prohibits the production, use, import, and export of decaBDE and decaBDE-containing products and articles for Parties to the listing decision for decaBDE, unless otherwise subject to a specific exemption (United Nations 2019). Due to this listing, EPA is requiring that all persons intending to export decaBDE or decaBDE-containing wire and cable for nuclear power generation facilities be required to notify EPA under TSCA section 12(b) and the provisions of subpart D in 40 CFR part 707. EPA recognizes that articles are generally exempt under 40 CFR 707.60(b) for notices of export under TSCA section 12(b). However, persons who export decaBDE contained in articles are not be exempt from the requirement to submit a notice of export respecting such decaBDE.

#### **Primary Alternative Option – DecaBDE**

**Plastic shipping pallets.** EPA considered requiring a label on all recycled plastic articles known to contain decaBDE. This label suggestion came from a government-to-government consultation and comments received after this consultation (Yurok Tribe 2023). Domestic manufacture of decaBDE has ceased; however, decaBDE-containing articles may still be imported into the United States. Due to the complexity of supply chains, it is difficult to identify at which point decaBDE is added in an article, hence making it difficult to determine where a label would be attached.

EPA also considered requiring respiratory and dermal PPE during all recycling processes of decaBDE-containing plastic products and articles. EPA explained in the 2021 PBT final rules, EPA it did not intend to use its TSCA section 6(a) authorities to restrict recycling activities generally. EPA did not reevaluate the practicability of further exposure reductions relating to prohibiting, or further regulatory restrictions on, the general recycling of decaBDE-containing plastic in the United States. In order to determine if decaBDE is present in plastics at recycling facilities, a testing program would need to be established. As described in the 2021 final decaBDE rule EPA maintains its position this it would be overly burdensome and not practicable to establish a testing program to determine the presence of decaBDE in recycled materials. A testing program is not assessed in this analysis.

#### **2.4.3 Phenol, isopropylated, phosphate (3:1) (PIP (3:1))**

EPA is considering regulatory requirements specific to each existing use of PIP (3:1). These uses are described in Section 3.3.2. The regulatory amendments that EPA is requiring, as well as the primary alternative option, are summarized in Table 2-10 and described in the sections below.

**Table 2-10: Summary of Final PIP (3:1) Risk Management Options**

Chemical Use	Final Option <sup>1,2</sup>	Primary Alternative Regulatory Option
Processing and distribution in commerce for use in lubricants and greases, PIP (3:1) containing products for use in lubricants and greases, and PIP (3:1)-containing lubricants and greases	<p>Modify exclusion for processing and distribution in commerce of PIP (3:1) for use in lubricants and greases and require PPE.</p> <ul style="list-style-type: none"><li>• Limit this exclusion to only aerospace use and turbine applications.</li><li>• Add a 15-year time limit to the exclusion for manufacturing, processing and distribution in commerce of any other lubricants and greases that contain PIP (3:1) and PIP (3:1)-containing products for use in); thus, non-turbine and non-aerospace uses will be prohibited after 15 years.</li><li>• Require a respirator at least as protective as a NIOSH-approved APF 10 air-purifying half mask respirator, and gloves that are chemically resistant to PIP (3:1) with activity-specific training where dermal contact with PIP (3:1) is possible that provide an impervious barrier to prevent dermal exposure during expected durations of use and normal conditions of exposure within the workplace during the manufacturing and processing of PIP (3:1) and PIP (3:1)-containing products for use in lubricants and greases.</li></ul>	Same as the Final Option, except using a 5-year time limit, rather than 15-years, to the exclusion for manufacturing, processing and distribution in commerce of PIP (3:1) and PIP (3:1)-containing products for use in any other lubricants and greases that contain PIP (3:1) and PIP (3:1)-containing products for use in); thus, non-turbine and non-aerospace uses would be prohibited after 5 years.
Processing and distribution in commerce of new and replacement parts for motor vehicles	<p>Modify compliance dates for processing and distribution in commerce of PIP (3:1) for use in new and replacement parts for motor vehicles and PPE during manufacturing and processing.</p> <ul style="list-style-type: none"><li>• Prohibit with 15-year phase-in the processing and distribution in commerce of PIP (3:1) and manufacturing, processing, and distribution in commerce of PIP (3:1)-containing products for use in parts for new motor vehicles (i.e., newly produced vehicles), and manufacturing and processing of PIP (3:1)-containing parts for such new vehicles.</li><li>• Prohibit with 30-year phase-in the processing and distribution in commerce of PIP (3:1) and manufacturing, processing, and distribution in commerce of PIP (3:1)-containing products for use in replacement parts for motor vehicles, and manufacturing and processing of PIP (3:1)-containing replacement parts for such vehicles.</li><li>• Require a respirator at least as protective as a NIOSH-approved N95 respirator (APF 10) and gloves that are chemically resistant to PIP (3:1) with activity-specific training where dermal contact with PIP (3:1) is possible during manufacturing and processing of PIP (3:1) and PIP (3:1)-containing products for use in new and replacement parts for motor vehicles. Processing of PIP (3:1)-containing parts to which PIP (3:1) has been added are excluded from this requirement.</li></ul>	No changes from 2021 Final Rule

**Table 2-10: Summary of Final PIP (3:1) Risk Management Options**

Chemical Use	Final Option <sup>1,2</sup>	Primary Alternative Regulatory Option
Processing and distribution in commerce of new and replacement parts for aerospace vehicles	<p>Prohibition phase-in dates for PIP (3:1)-containing new and replacement parts for aerospace vehicles.</p> <ul style="list-style-type: none"><li>Prohibit the manufacturing, processing and distribution in commerce of PIP (3:1) and PIP (3:1)-containing products for use in new and replacement parts for aerospace vehicles after 30 years;</li><li>After the end of the aerospace vehicles service lives, prohibit the importing, processing and distribution of aerospace vehicles manufactured before the 30-year prohibition is in effect.</li><li>Prohibit manufacturing, processing and distribution in commerce of PIP (3:1), PIP (3:1)-containing products, and PIP (3:1)-containing replacement parts after the end of the vehicle service life. (Allow replacement parts that contain PIP (3:1) through the life cycle of the vehicle.)</li><li>Require a respirator at least as protective as a NIOSH-approved N95 respirator (APF 10) and gloves that are chemically resistant to PIP (3:1) with activity-specific training where dermal contact with PIP (3:1) is possible during manufacturing and processing of PIP (3:1) and PIP (3:1)-containing products for use in new and replacement parts for aerospace vehicles. Processing of PIP (3:1)-containing parts to which PIP (3:1) has been added are excluded from this requirement.</li></ul>	No changes from 2021 Final Rule
Processing and distribution in commerce for use in wire harnesses and electric circuit boards	<p>Exclusion for the processing and distribution of PIP (3:1), PIP (3:1)-containing products for use in circuit boards and wire harnesses, including but not limited to terminal and fuse covers, cable sleeves, casings, connectors and tapes, and PIP (3:1)-containing circuit boards and wire harnesses including but not limited to terminal and fuse covers, cable sleeves, casings, connectors and tapes.</p> <ul style="list-style-type: none"><li>Require a respirator at least as protective as NIOSH-approved APF 10 air-purifying half mask respirator and gloves that are chemically resistant to PIP (3:1) with activity-specific training where dermal contact with PIP (3:1) is possible during manufacturing and processing of PIP (3:1) for use in wire harnesses or electric circuit boards.</li></ul>	Prohibit manufacturing (including import), processing, and distribution and commerce of PIP (3:1) for use in circuit boards and wire harnesses, including but not limited to terminal and fuse covers, cable sleeves, casings, connectors and tapes, and PIP (3:1)-containing circuit boards and wire harnesses including but not limited to terminal and fuse covers, cable sleeves, casings, connectors and tapes, after 20 years.

**Table 2-10: Summary of Final PIP (3:1) Risk Management Options**

Chemical Use	Final Option <sup>1,2</sup>	Primary Alternative Regulatory Option
Manufacturing (import) and distribution in commerce of PIP (3:1) that is intended for formulation into a FIFRA-registered marine antifouling coating	<p>Provide an exclusion of 5 years for the processing and distribution in commerce of PIP (3:1) for use in FIFRA-registered marine anti-fouling coatings only for products that meet Department of Defense specification requirements.</p> <ul style="list-style-type: none"><li>Require a respirator at least as protective as a NIOSH-approved APF 10 air-purifying half mask respirator and gloves that are chemically resistant to PIP (3:1) with activity-specific training where dermal contact with PIP (3:1) is possible during manufacturing and processing of PIP (3:1)-for use in FIFRA-registered marine antifouling coating.</li></ul>	No changes from 2021 Final Rule
Processing and distribution in commerce for use in semiconductor manufacturing, and electronic, HVACR and water heating, and power generating equipment manufacturing.	<p>Prohibition phase-in dates for PIP (3:1)-containing new and replacement parts for products and articles for use installed in equipment in a variety of industries: manufacturing, semiconductor manufacturing, electronic, HVACR and water heating, and power generating.</p> <ul style="list-style-type: none"><li>Prohibit the processing and distribution of PIP (3:1) and PIP (3:1)-containing products and articles for use in new parts installed in equipment in a variety of industries: manufacturing, semiconductor manufacturing, electronic, HVACR and water heating, and power generating after 10 years.</li><li>Prohibit the processing and distribution of PIP (3:1) and PIP (3:1)-containing replacement parts in manufacturing equipment, including semiconductor manufacturing after the end of the products service life.</li><li>Prohibit the processing and distribution of PIP (3:1) and PIP (3:1)-containing replacement parts in electronic equipment after 7 years for personal use, 25 years for commercial use, and after the products service life for laboratory use.</li><li>Prohibit the processing and distribution of PIP (3:1) and PIP (3:1)-containing replacement parts in HVACR and water heating equipment after 25 years.</li><li>Prohibit the processing and distribution of PIP (3:1) and PIP (3:1)-containing replacement parts in power generating equipment after 25 years.</li><li>Require a respirator at least as protective as a NIOSH-approved APF 10 air-purifying half mask-respirator and gloves that are chemically resistant to PIP (3:1) with activity-specific training where dermal contact with PIP (3:1) is possible during manufacturing and processing for use in PIP (3:1)-containing manufacturing equipment or semiconductors. Processing of PIP (3:1)-containing parts to which PIP (3:1) has been added are excluded from this requirement.</li></ul>	Same as the Final Option, except using a 20-year time limit, rather than 10 years, to the exclusion for manufacturing, processing and distribution in commerce of PIP (3:1) and PIP (3:1)-containing products for use in semiconductor manufacturing, and electronic, HVACR and water heating, and power generating equipment manufacturing.

**Table 2-10: Summary of Final PIP (3:1) Risk Management Options**

Chemical Use	Final Option <sup>1,2</sup>	Primary Alternative Regulatory Option
Processing and distribution in specialized engine filters for locomotive and marine applications	Require half or full respirators, and gloves that are chemically resistant to PIP (3:1) with activity-specific training where dermal contact with PIP (3:1) is possible for workers using PIP (3:1) in the manufacturing of specialized engine filters for locomotive and marine applications. Processing of PIP (3:1)-containing parts are excluded from this requirement.	No changes from 2021 Final Rule
Processing and distribution in intermediate in a closed system to produce cyanoacrylate adhesives	Require respiratory protection that must be at least as protective as a NIOSH-approved APF 50 respirator, except when the PIP (3:1) or PIP (3:1)-containing product is contained in a closed-system. Codify requirements for engineering controls of closed loop, as well as local exhaust ventilation and general ventilation.	No changes from 2021 Final Rule
Processing and distribution in aviation hydraulic fluids	Require a respirator at least as protective as a NIOSH-approved APF 10 air-purifying half mask respirator and gloves that are chemically resistant to PIP (3:1) with activity-specific training where dermal contact with PIP (3:1) is possible during manufacturing and processing of any PIP (3:1)-containing aviation hydraulic fluid.	No changes from 2021 Final Rule

<sup>1</sup> In response to public comments on the NPRM, the final rule also establishes a regulatory threshold level. This exclusion prohibits manufacturing, processing, and distribution in commerce of PIP (3:1)-containing products and articles, unless PIP (3:1) concentrations are at or below 0.1% by weight, not including any amount present due to excluded uses, including recycling, or uses that have not yet been phased out.

<sup>2</sup> EPA is also amending the downstream notification statement that must accompany shipments of PIP (3:1) or PIP (3:1) containing products to conform to the terms of the prohibitions in the final rule. EPA is providing a 3-month transition period to update SDS sheets and an 18-month transition period for updating labels. During the 3-month transition period, downstream notification under 40 CFR 751.407(e)(1) and (2) is still required; entities may use the new information provided in new 40 CFR 751.407(e)(3) or existing notification consistent with the restrictions described in this subpart. During the 15-month period between the SDS revision date and the label revision date, manufacturers, processors or distributors are required to provide the updated SDS with the “new” information when distributing products with the “old” label.

### Final Amendments – PIP (3:1)

As noted previously, this final rule addresses public comments received on the NPRM requesting that EPA establish a regulatory threshold for quantities of PIP (3:1) and decaBDE in products and articles. The final rule sets a threshold level of 0.1 percent for both decaBDE and PIP (3:1). Using this threshold concentration, the bans on manufacturing, processing, and distributing in commerce products and articles only apply to products and articles containing more than 0.1 percent decaBDE by weight or 0.1 percent PIP (3:1) by weight, not counting decaBDE or PIP (3:1) in products or articles that are excluded from the bans or for which the delayed bans have not reached their compliance date.

In addition, as detailed in the preamble to this final rule, EPA does not believe, unless otherwise specified, that products and articles containing PBT chemicals should continue to be distributed without end, and therefore is not adopting a generally applicable “manufactured by” provision. EPA acknowledges that retailers and distributors may keep some amount of stock on hand and may not have ways to track which inventory may be subject to a prohibition. EPA agrees with commenters that it would not be practicable to force retailers to dispose of stocks, disrupting supply chains and potentially be costly. Hence, for practicability reasons EPA is providing longer “sell through” dates for distribution of articles containing PIP (3:1) for those articles with a compliance date of October 31, 2024. Instead, EPA has finalized specific phase-in prohibitions or exclusions for certain PBT-containing articles and finalized an exclusion solely for the purpose of repair and maintenance of an existing article. However, to

discourage stockpiling, EPA is not providing for a sell-through provision for those articles covered by a phase-in prohibition, in particular for new and replacement parts.

EPA is also amending the downstream notification statement that must accompany shipments of PIP (3:1) or PIP (3:1) containing products to conform to the terms of the prohibitions in the final rule. EPA is providing a 3-month transition period to update SDS sheets and an 18-month transition period for updating labels. EPA believes that this transition period will allow time to clear product with old labels through channels of trade. During the 3-month transition period, downstream notification under 40 CFR 751.407(e)(1) and (2) is still required; entities may use the new information provided in new 40 CFR 751.407(e)(3) or existing notification consistent with the restrictions described in this subpart. During the 15-month period between the SDS revision date and the label revision date, manufacturers, processors or distributors are required to provide the updated SDS with the “new” information when distributing products with the “old” label.

**Lubricants and greases.** EPA applies an exclusion for manufacturing, processing, and distribution in commerce of PIP (3:1) for use in lubricants and greases, PIP (3:1)-containing products for use in lubricants and greases, and PIP (3:1)-containing lubricants and greases in 40 CFR part 751.407(b)(ii) to only lubricants and greases for aerospace and turbine engine applications. The Agency is also including a 15-year time limit to the exclusion for manufacturing, processing and distribution in commerce of any other lubricants and greases that contain PIP (3:1) and PIP (3:1)-containing products. The Agency’s NPRM proposed a 5-year time limit, however several public commenters raised concerns that they will not have access to these critical products that meet their unique performance criteria, and that alternatives have not yet been identified for all PIP-containing lubricants and greases. Therefore, EPA is extending the phase-out of lubricants and greases from 5 to 15 years so that PIP (3:1) can be phased-out of these products while accounting for the time needed to find suitable alternatives that meet the performance criteria for these industries.

EPA has acknowledged and continues to acknowledge the degree to which PIP (3:1) is a crucial anti-wear component for aerospace lubricants and greases, which need to perform at a wide range of temperatures and pressures. EPA understands there are some non-aerospace uses of these lubricants and greases where PIP (3:1) is a crucial anti-wear component, such as turbines used in power generation or in marine settings (Akin Gump Strauss Hauer & Feld LLP (Akin Gump) 2017). However, uses in non-aircraft machinery and non-turbine equipment may not be subject to these same environmental stresses or safety and performance requirements from industry and government as uses in the aerospace sector. EPA believes a 15-year phase-in prohibition is practicable amount of time for users to research, formulate, and test alternative products for such non-aerospace, non-turbine uses. This timeframe also aligns with the 15-year phase-out for new parts for motor vehicles.

**New and replacement parts for motor vehicles.** EPA is modifying the exclusion for new and replacement auto parts in 40 CFR 751.407(b)(1)(iii). Specifically, EPA is changing the exclusion for use of PIP (3:1) in new and replacement parts for motor vehicles so that after 15 years, processing and distribution in commerce of PIP (3:1) and processing and distribution of PIP (3:1)-containing products for use in parts, not covered by an exclusion, installed in and distributed as part of new motor vehicles, including heavy motorized machinery, and the parts to which PIP (3:1) has been added for such motor vehicles, including heavy motorized machinery, will be prohibited. Similarly, after such time, the importing, processing, and distribution of motor vehicles, including heavy motorized machinery, that contain PIP (3:1) parts not covered by an exclusion will be prohibited.

EPA is also allowing processing and distribution in commerce for an additional 15 years (i.e., through 30 years after publication date of the final rule), for PIP (3:1) and PIP (3:1)-containing products for use in

replacement parts and PIP (3:1)-containing replacement parts for use in motor vehicles, including heavy motorized machinery. Allowing these parts to be distributed for an additional 15 years is consistent with industry practices, the National Transport and Safety Authority (NTSA) legal requirements and would allow the clearing of these replacement parts through the supply chain. This additional time for processing and distribution of replacement parts does not impose costs on industry and will not be assessed further in this analysis.

EPA generally interprets the term “motor vehicle” to mean a transport vehicle that is propelled or drawn by mechanical power, such as cars, trucks, motorcycles, boats, and construction, agricultural, and industrial machinery. EPA is including a reference to “heavy motorized machinery” in the exclusion to clarify this.

**New and replacement parts for aerospace vehicles.** EPA is amending the exclusion for new and replacement parts for aerospace vehicles described in 40 CFR 751.407(b)(1)(iii). This includes a prohibition on the processing and distribution in commerce of PIP (3:1) and for processing and distribution in commerce of PIP (3:1)-containing products, for use in new and replacement parts for aerospace vehicles, after 30 years. EPA is prohibiting the manufacture, processing, and distribution in commerce of PIP (3:1) for use in replacement parts for aerospace vehicles, and the replacement parts to which PIP (3:1) has been added for such vehicles that commences after the end of their service lives. The additional time for processing and distribution of replacement parts (until after the end of their service lives) does not impose costs on industry and will not be assessed further in this analysis.

**Wire harnesses and circuit boards.** EPA is amending 40 CFR 751.407 to include an exclusion for the processing and distribution of PIP (3:1), PIP (3:1)-containing products for use in wire harnesses and circuit boards, and for wire harnesses and circuit boards containing PIP (3:1). This exclusion for use in wire harnesses and circuit boards is based on industry comments provided in response to the March 2021 notification opening a comment period. EPA interprets wire harness to include a broad class of articles, including but not limited to terminal and fuse covers, cable sleeves, casings, connectors and tapes used in a variety of applications, from defense to aerospace and motor vehicle applications, to medical instrumentation and more. In these articles, PIP (3:1) is used as a plasticizer and flame retardant. Hence, EPA is also excluding the processing and manufacturing of PIP (3:1) and PIP (3:1)-containing products for use in adhesives and sealants in electronic component manufacturing.

In the January 2021 PIP (3:1) final rule, EPA finalized a prohibition on the use of PIP (3:1) in adhesives and sealants and PIP (3:1)-containing adhesives and sealants after January 6, 2025. In the March 2022 PIP (3:1), EPA extended the compliance deadline to October 31, 2024 for articles not otherwise addressed by an exclusion or phased-in prohibition. This exclusion for wire-harnesses and circuit boards applies to articles that would have been subject to either the 2024 compliance deadline and certain products subject to the 2025 compliance deadline. EPA is allowing for the exclusion of adhesive and sealants used in or on circuit boards and is thus adding this exclusion to 40 CFR 751.407 (b).

**Marine anti-fouling coatings products.** EPA is adding a time-limited exclusion for processing and distribution of PIP (3:1) for use in a FIFRA-registered marine anti-fouling coating products for products that meet Department of Defense specification requirements. The January 2021 prohibition on processing and distribution of PIP (3:1) has prohibited the U.S. Navy from procuring PIP (3:1) for use in a FIFRA-registered marine anti-fouling coating products. This time-limited exclusion will allow the Navy to continue to procure PIP (3:1) while it completes its development of an alternative PIP (3:1)-free formulation. EPA is putting in place a five-year compliance deadline for use of PIP (3:1) in a FIFRA-approved marine antifouling coating products.

***Manufacturing equipment and semi-conductor manufacturing equipment, new and replacement parts.***

EPA is amending 40 CFR 751.407(a)(2) to add a compliance deadline of 10 years for processing and distribution in commerce of PIP (3:1)-containing articles for use in new parts installed in equipment in a variety of industries: manufacturing, semiconductor manufacturing, electronic, HVACR and water heating, and power generating. After the January 2021 PIP (3:1) final rule was published, a number of stakeholders from a variety of industrial sectors, including the electronics and electrical manufacturing, semiconductor manufacturing, and equipment and heavy equipment manufacturing equipment, requested an extension of the compliance date to clear the existing articles through the supply chain, find and certify an alternative chemical, and produce or import new articles or complex goods that do not contain PIP (3:1). These stakeholders informed EPA of the use of PIP (3:1) as a flame retardant and plasticizer in plastic components such as wire covers and casings. Other components that were identified, include, but are not limited to, PVC tubes, harnesses, cables, covers, sleeves, and casings, as well as internal components of high-tech robotics and manufacturing equipment, in components in scanning electron microscopes utilized in research, national laboratories, academia, in manufacturing and electronic components utilized for electronic design and assembly, and in electronics and semiconductor manufacturing equipment. EPA is amending the provision to allow the processing and distribution in commerce of PIP (3:1) for use in articles and of PIP (3:1)-containing articles for use in new parts installed in equipment in a variety of industries: manufacturing, semiconductor manufacturing, electronic, HVACR and water heating, and power generating for an additional 10 years. EPA is also amending the recordkeeping for these and other articles that have PIP (3:1) in them, up and until the date of prohibition, in an effort to increase transparency of PIP (3:1) in supply chains.

For associated replacement parts, 40 CFR 751.407(a)(2)(ix) add varying compliance deadlines for parts installed in equipment in a variety of industries: manufacturing, semiconductor manufacturing, electronic, HVACR and water heating, and power generating equipment. This includes prohibiting the processing and distribution of PIP (3:1) and PIP (3:1)-containing replacement parts in manufacturing equipment, including semiconductor manufacturing after the end of the products service life. The processing and distribution of PIP (3:1) and PIP (3:1)-containing replacement parts in electronic equipment is prohibited after 7 years for personal use, 20 years for commercial use, and after the products service life for laboratory use. The rule prohibits the processing and distribution of PIP (3:1) and PIP (3:1)-containing replacement parts in HVACR, water heating equipment, and power generating equipment after 25 years.

***Worker protection (PPE) requirements (all Options).*** To ensure minimal potential for exposure to workers during domestic manufacturing and processing, the owner or operator must demarcate regulated areas from the rest of the workplace in a manner that adequately establishes and alerts persons to the boundaries of the regulated area and minimizes the number of authorized persons exposed to PIP (3:1) within the regulated area. The final rule also requires inhalation and dermal PPE during manufacturing and processing of PIP (3:1) and PIP (3:1)-containing products and articles, which will impact the excluded activities under the 2021 final PIP (3:1) rule and uses with compliance date extensions under this ruling. EPA is not requiring PPE for distribution in commerce, or processing of certain PIP (3:1)-containing articles (i.e., new and replacement parts for motor and aerospace vehicles to which PIP (3:1) has already been added, motor and aerospace vehicles that contain new and replacement parts containing PIP (3:1), PIP (3:1)-containing specialized air filters for locomotive and marine applications, plastic for recycling from products or articles containing PIP (3:1), and finished products or articles made of plastic recycled from PIP (3:1) containing-products or articles) since the handling and processing of these articles would result in minimal potential for worker exposure (U.S. Environmental Protection Agency (EPA) 2020b).

EPA is requiring implementation of a PPE program in alignment with OSHA's General Requirements for Personal Protective Equipment at 29 CFR 1910.132. Consistent with 29 CFR 1910.132 and 29 CFR 1910.134, owners and operators are required to provide PPE, including respiratory and dermal protection of safe design and construction appropriate for the work to be performed. EPA is requiring owners and operators to ensure that each potentially exposed person who is required to wear PPE to use and maintain PPE in a sanitary, reliable, and undamaged condition. Owners and operators are required to select and provide PPE that properly fits each potentially exposed person who is required to use PPE and communicate PPE selections to each affected person.

While EPA is implementing a PPE program in alignment with OSHA, EPA is also prescribing the level of PPE that must be worn based on the information EPA has regarding the adoption of those levels by industry. Where EPA is prescribing the use of PPE, EPA is not supplanting OSHA requirements, but clarifying the level of PPE that EPA believes is practicable under TSCA section 6(h). For the manufacturing and processing of PIP (3:1), and PIP (3:1) products for use in hydraulic fluid, wire harnesses and circuit boards, and articles used in manufacturing equipment and in the semiconductor industry (including in semiconductor manufacturing equipment), EPA is requiring, a respirator at least as protective as a NIOSH-approved APF 10 air-purifying half mask respirator and chemical resistant gloves that provide an impervious barrier to prevent dermal exposure during expected durations of use and normal conditions of exposure within the workplace. Processing of PIP (3:1)-containing parts to which PIP (3:1) has been added are excluded from this requirement. For the manufacturing of PIP (3:1) and PIP (3:1) products for use in new and replacement parts for motor, including heavy motorized machinery, and aerospace vehicles, EPA is requiring a respirator at least as protective as a NIOSH-approved APF 10, air-purifying filtering facepiece/dust mask respirator (commonly referred to as an N95 mask), and gloves that are chemically resistant to PIP (3:1) with activity-specific training where dermal contact with PIP (3:1) is possible. For processing of PIP (3:1) and PIP (3:1)-containing products for use in the manufacturing of cyanoacrylate adhesives, EPA is requiring respiratory protection which must be at least as protective as a NIOSH-approved APF 50 respirator, except when the PIP (3:1) or PIP (3:1)-containing product is contained in a closed-system. For the use of PIP (3:1) in the manufacturing of specialized engine filters for locomotive and marine applications, EPA is requiring that workers be provided half or full respirators and gloves that are chemically resistant to PIP (3:1) with activity-specific training where dermal contact with PIP (3:1) is possible. Based on stakeholder comments (Daikin Industries 2019) and OSHA required Safety Data Sheets, EPA believes these levels of protection are used as industry best practices, although EPA lacks sufficient information to determine the scale of adoption.

While EPA is requiring PPE in alignment with OSHA, EPA is also prescribing the level of PPE that must be worn where EPA has information regarding the adoption of those levels by industry. For industries in which EPA believes PPE is industry standard, EPA is codifying existing industry practice. For those in which EPA believes PPE is used by some workers, but not widely adopted, EPA is prescribing PPE. Where EPA is prescribing the use of PPE, EPA is not supplanting OSHA requirements, but clarifying the level of PPE that EPA believes is practicable under TSCA section 6(h). EPA's requirements are as follows:

- For the manufacturing and processing of PIP (3:1), and PIP (3:1)-containing products for use in hydraulic fluid, wire harnesses and circuit boards, and articles used in manufacturing equipment, including semiconductor manufacturing, electronic, HVACR and water heating, and power generating equipment, EPA is requiring, at a minimum, a respirator at least as protective as a NIOSH-approved APF 10 air-purifying half mask respirator and chemical resistant gloves that provide an impervious barrier to prevent dermal exposure during expected durations of use and normal conditions of exposure within the workplace.

- For the manufacturing of PIP (3:1) and PIP (3:1) products for use in new and replacement parts for motor, including heavy machinery, and aerospace vehicles, EPA is requiring a respirator at least as protective as a NIOSH-approved APF 10, air-purifying filtering facepiece/dust mask respirator (commonly referred to as an N95 mask), and gloves that are chemically resistant to PIP (3:1) with activity-specific training where dermal contact with PIP (3:1) is possible.
- For the manufacturing and processing of PIP (3:1) and PIP (3:1) containing products for use in lubricants and greases and as an intermediate in the closed loop production of cyanoacrylate adhesives, EPA is requiring, at a minimum, a respirator at least as protective as a NIOSH-approved APF 50 and gloves that are chemically resistant to PIP (3:1) with activity-specific training where dermal contact with PIP (3:1) is possible.
- For the use of PIP (3:1) in the manufacturing of specialized engine filters for locomotive and marine applications, EPA is requiring that workers be provided half or full respirators and gloves that are chemically resistant to PIP (3:1) with activity-specific training where dermal contact with PIP (3:1) is possible.

For APF 10 respirators, EPA is requiring that the owner or operator must ensure that all respirators used in the workplace are NIOSH-approved as listed on the NIOSH Certified Equipment List. In choosing appropriate gloves, EPA is requiring that owners and operators consider effectiveness of glove type when preventing exposures from PIP (3:1) alone and in likely combination with other chemical substances used in the work area, degree of dexterity required to perform tasks, and temperature, as identified in the Hand Protection section of OSHA's Personal Protective Equipment guidance (Occupational Safety and Health Administration (OSHA) 2004). EPA is requiring owners and operators in these manufacturing and processing uses to provide and require wearing of the specified PPE to persons potentially exposed to PIP (3:1) or PIP (3:1)-containing products or articles.

EPA is requiring each owner or operator comply with OSHA's general PPE training requirements at 29 CFR 1910.132 and 29 CFR 1910.134 for selection, proper use, maintenance and training when using respirators and gloves. EPA is requiring that owners and operators provide PPE training to each potentially exposed person who is required to wear PPE prior to or at the time of initial assignment to a job involving potential exposure to PIP (3:1). Owners and operators also have to re-train each affected person at least once annually or whenever the owner or operator has reason to believe that a previously trained person does not have the required understanding and skill to properly use PPE, or when changes in the workplace or in the PPE to be used render the previous training obsolete.

EPA requires that owners and operators document in the PPE program the following information, as applicable:

- (A) The name, workplace address, work shift, job classification, and work area of each person reasonably likely to directly handle PIP (3:1) or handle equipment or materials on which PIP (3:1) may present and the type of PPE selected to be worn by each of these persons;
- (B) The basis for PPE selection (e.g., demonstration based on permeation testing or manufacturer specifications that each item of PPE selected provides an impervious barrier to prevent exposure during expected duration and conditions of exposure, including the likely combinations of chemical substances to which the PPE may be exposed in the work area); and
- (C) Appropriately sized PPE and training on proper application, wear, and removal of PPE, and proper care/disposal of PPE.

EPA is requiring each owner or operator supply PPE, selected in accordance with this unit, to each potentially exposed person within 60 days after publication of the final rule.

**Cyanoacrylate adhesives.** EPA is requiring engineering controls for the use of PIP (3:1) in the manufacturing of cyanoacrylate adhesives. EPA is requiring engineering controls for the use of PIP (3:1) as an intermediate in the production of cyanoacrylate adhesives such that the processing of PIP (3:1) must take place in a closed loop and general and local area ventilation must be provided.

**Primary Alternative Option – PIP (3:1)**

EPA considered an alternative regulatory action that would modify the existing exclusions as follows.

**Lubricants and greases.** EPA considered a 5-year time limit on manufacturing (including import) and processing of PIP (3:1) for end use lubricants and greases, with a prohibition on manufacturing, processing, and industrial/commercial use occurring at 5 years.

**Wire harnesses and circuit boards.** EPA considered a 20-year time limit on manufacturing (including import) for PIP (3:1) used for wire harnesses and electric conduit boards. EPA also considered a 20-year time limit on manufacturing (including import), processing, and distribution and commerce for PIP (3:1) present in wire harnesses and electric conduit boards. Articles with an end use in new and replacement parts vehicles would be exempt from this time limit.

**Manufacturing equipment and semi-conductor manufacturing equipment, new and replacement parts.** EPA considered a 20-year time limit on manufacturing (including import) for PIP (3:1) used for manufacturing equipment, and in the semiconductor industry. EPA also considered a 20-year time limit on manufacturing (including import), processing, and distribution and commerce for PIP (3:1) present in the semiconductor manufacturing industry and electronic, HVACR and water heating, and power generating equipment manufacturing.

### 3. Profile of Affected Industries and Entities (Baseline)

This chapter provides background information on the industry sectors and entities potentially affected by the final rule.

#### 3.1 Key Data Sources

Data used in this chapter are primarily sourced from EPA's Chemical Data Reporting (CDR), from the proprietary Descartes Datamyne database, D&B Hoovers database, and Experian's TargetIQ database. These sources, and their limitations, are described below.

Other secondary sources and contacts with industry representatives were also used to provide data. These other data sources were used as described in each applicable section.

##### **Chemical Data Reporting (CDR)**

The CDR rule under TSCA requires manufacturers (including importers) to provide information to EPA every four years on the chemicals they manufacture or import into the United States. Table 3-1, below, presents the various conditions under which a facility subject to TSCA must report to CDR. Typically, a manufacturer is required to report any volume above 25,000 pounds, while small manufacturers<sup>12</sup> are only required to report any volume above 100,000 pounds. However, the chemicals regulated under this rulemaking are subject to a 2,500 lbs. reporting threshold, with no small manufacturer exemption, because they are already regulated under a TSCA section 6 rule. Data collected under CDR for each chemical include the company name, volume of each chemical manufactured/imported, the number of workers at each site, and information on whether the chemical is used in the industrial, commercial, and/or consumer sector. Exemptions apply to small manufacturers. CDR can be accessed at <https://www.epa.gov/chemical-data-reporting>.

**Table 3-1: Conditions Under Which a Company Must Report to CDR**

TSCA Action	Subject to 25,000 lbs. reporting threshold	Subject to 2,500 lbs. reporting threshold	Not eligible for certain full or partial exemptions from reporting	Not eligible for small manufacturer exemption
Not subject to TSCA action	✓			
TSCA section 4 rules (proposed or promulgated)	✓		✓	✓
Enforceable Consent Agreements (ECAs)	✓		✓	
TSCA section 5(a)(2) SNURs (proposed or promulgated)		✓	✓	
TSCA section 5(b)(4) rules (proposed or promulgated)		✓	✓	✓
TSCA section 5(e) orders		✓	✓	✓
TSCA section 5(f) orders		✓	✓	
TSCA section 5 civil actions		✓	✓	✓
TSCA section 6 rules (proposed or promulgated)		✓	✓	✓

**Source:** U.S. Environmental Protection Agency (EPA) 2017c  
**Note:** Shaded row is applicable to decaBDE and PIP (3:1)

<sup>12</sup> The definition of a small manufacturer varies depending on the sector in which it operates.

### ***Descartes Datamyne Database***

Datamyne collects import data on shipments into the United States and provides information on each shipment. Datamyne is a commercial searchable trade database that covers the import-export data and global commerce of more than 50 countries across five continents (approximately 85% of the world's import trade by value) and includes the cross-border commerce of the United States with over 230 trading partners (Descartes Datamyne 2023). The trade data are gathered from U.S. Customs Automated Manifest System. For this analysis, EPA queried the database for bills of lading related to each of the chemicals subject to the rule as described in the sections below. Due to the nature of Datamyne data, some shipments containing the chemical of concern may be excluded due to being categorized under other names that were not included in the search terms. There also may be typos in the data that prevent shipment records containing the chemical from being located. Datamyne does not include articles/products containing the chemical unless the chemical name is included in the description of the article/product.

### ***D&B Hoovers***

Business statistics (revenue and number of employees) for some companies were gathered using the proprietary Dun & Bradstreet (D&B) Hoovers database, a comprehensive information source containing entries on over 120 million companies. The data may be limited by how recently each company's information is updated; entries vary by company.

### ***Experian***

Business statistics (revenue and number of employees) for some companies were gathered using the Experian Business TargetIQ database, which provides comprehensive, third-party verified information on 99.9 percent of all U.S. companies and millions of companies worldwide. Experian receives public record information from government and vendor sources on a daily, weekly, monthly or quarterly schedule. Once Experian receives public record updates from the government or vendor sources, turnaround time for formatting, cleansing and loading data is generally 48 to 72 hours.

### ***Census: Statistics of U.S. Businesses (SUSB)***

The Statistics of U.S. Businesses (SUSB) is an annual series by the United States Census Bureau that provides national and subnational data on the distribution of economic data by enterprise size and industry. Data are presented by geographic area, industry detail, and enterprise size. Annual data consist of number of firms, number of establishments, employment during the week of March 12 for a given year, and annual payroll. In addition, receipts data are included for years ending in 2 or 7 (i.e., 2007, 2012, 2017, 2022 etc.). The series generally covers all U.S. business establishments with paid employees. The SUSB covers all NAICS industries except crop and animal production; rail transportation; postal service; pension, health, welfare, and vacation funds; trusts, estates, and agency accounts; office of notaries; private households; and public administration. The SUSB also excludes most government employees. Tabulations providing data by employment size of enterprise have been assembled as far back as 1989. These data were developed in cooperation with, and partially funded by, the Office of Advocacy of the U.S. Small Business Administration (SBA). SUSB can be accessed at: <https://www.census.gov/programs-surveys/susb.html>.

## 3.2 Decabromodiphenyl ether (DecaBDE)

### 3.2.1 Manufacture/Import

In December 2009, the largest producers and suppliers of decaBDE in the United States committed to end their production, imports, and sales for all uses of the chemical by the end of 2013 (U.S. Environmental Protection Agency (EPA) 2014a). Data from the 2016 CDR shows that production of decaBDE has dropped dramatically from 2006 to 2016, and continued at a low level through 2019, supporting this commitment. Table 3-2 presents the historical production volume of decaBDE from the Inventory Update Rule (IUR) and CDR from 1986 to 2019.

**Table 3-2: 1986 to 2019 National Production Volume Data for DecaBDE**

Year	Non-Confidential Production Volume in Pounds
1986 to 2002	10 to 100 M
2006	50 to 100 M
2011	18,110,827
2012	10 to 50 M
2013	1 to 10 M
2014	100 to 500 K
2015	<25 K
2016	<1 M
2017	<1 M
2018	<1 M
2019	<1 M

**Note:** M = million, K = thousand  
**Sources:** (U.S. Environmental Protection Agency (EPA) 2010b; U.S. Environmental Protection Agency (EPA) 2017a; U.S. Environmental Protection Agency (EPA) 2020a)

According to the most recent CDR data collection (2020), decaBDE was manufactured or imported by three companies in the United States for Reporting Year (RY) 2019. Table 3-3 presents these manufacturers or importers of decaBDE. The information presented in this table does not represent all of the facilities potentially manufacturing, producing, and/or using decaBDE because only certain industries and types of facilities are required to report to CDR, though EPA does not expect for there to be any companies manufacturing decaBDE below the reporting thresholds.<sup>13</sup>

Based on the CDR data, domestic manufacture of decaBDE has ceased, but decaBDE may continue to be imported to the United States. The 2020 CDR data indicate that import volume increased from 2018 to 2019; however, EPA notes that the identified importers have likely since stopped using decaBDE. One of the importers, Rockland Industries, was expected to cease use of decaBDE by July 2022 as, all persons are prohibited from all manufacture, processing and distribution in commerce of decaBDE for use in curtains in the hospitality industry under the 2021 final rule (40 CFR § 751.405(a)(2)(i)). The other identified importer, Metals and Additives LLC is a private holding company for Polymer Additives Group the manufacturer of BroFlam DB-17, a flame retardant containing decaBDE (Polymer Additives Group 2018), but which is no longer sold in the United States or anywhere else (Ficarro 2022).

<sup>13</sup> Please refer to Section 3.1 for information on who is required to report to CDR.

**Table 3-3: U.S. Manufacturers and Importers of DecaBDE (CAS RN 1163-19-5)**

Parent Company	Site	Manufacture or Import	Manufactured Volume (2019) (lbs./yr)	Imported Volume (2019) (lbs./yr)	Past Production Volume (2018) (lbs./yr)	Type of Process or Use	Industrial Sector	Category of Use
Rockland Industries, Inc.	Rockland Bamberg Industries 253 Calhoun Street Bamberg, SC 29003	Import	0	176,367	132,275	Processing-incorporation into article	Textiles, apparel, and leather manufacturing	Flame retardant
Metals and Additives LLC (dba Omni Oxide)	Omni Oxide Indiana Oxide 10665 N St Rd 59 Brazil, IN 47834	Import	0	22,046	4,409	Processing-incorporation into formulation, mixture, or reaction product	Plastics Material and Resin Manufacturing	Flame retardant
CBI	CBI	CBI	CBI	CBI	CBI	Processing-incorporation into formulation, mixture, or reaction product	Plastics Material and Resin Manufacturing	Flame retardant

Source: U.S. Environmental Protection Agency (EPA) 2020a

For additional importer data, the Datamyne database was queried for records from 2021<sup>14</sup> to September 2022 using “decabromodiphenyl\* ANDNOT ethane\*” as a search term in order to limit false hits. Results are provided in Table 3-4. Due to the nature of Datamyne data, some shipments containing decaBDE may be excluded due to being categorized under different chemical names or synonyms. There also may be typos in the data that prevent shipment records containing decaBDE from being located. Import data do not include imported articles that contain decaBDE, which could constitute another potential portion of decaBDE entering the United States. There also may be typos in the data that prevent shipment records containing decaBDE from being located. Import data do not include imported articles that contain decaBDE, which could constitute another potential portion of decaBDE entering the United States. The total weight represents the shipment weight, not the weight of decaBDE specifically.

**Table 3-4: U.S. Importers of DecaBDE, 2021 to 2022**

Consignee Declared (Importer)	Use Category	Number of Shipments			
		March to December 2021	Total Weight (kg)	January to September 2022	Total Weight (kg)
MB TECHNOLOGY INC	Roofing systems	1	3,580	1	10,200
PACIFIC COAST ENTERPRISE, INC.	Distribution (textiles)	1	18,300	0	0
SANKO U.S.A., INC.	Chemical manufacturer (including flame retardants)	1	20,260	0	0
<b>Grand Total</b>		<b>3</b>	<b>42,140</b>	<b>1</b>	<b>10,200</b>

Based on Datamyne data, import of decaBDE into the United States decreased significantly in recent years and is believed to have now ceased. The only import of the chemical from January to September 2022 was for use in roofing systems. Use of decaBDE in building and construction materials (such as roofing systems) and in textiles was prohibited under the 2021 final rule.

### 3.2.2 Regulated Uses

DecaBDE is considered the most effective of the brominated flame retardants for certain uses. Flame retardants have been used in a variety of industries and applications to prevent a fire from occurring or slow down the spread of a fire. Because relatively small quantities of decaBDE are required for outstanding flame retardant properties, it has minimal influence on the physical and mechanical properties of the product in which it is used (IHS Specialty Chemicals Update Program (IHS SCUP) 2014).

EPA’s economic analysis for the January 2021 final rule described the historical uses of decaBDE as well as the uses that were currently ongoing during the development of that rule. The 2021 final rule prohibited several of those ongoing uses. This economic analysis focuses on certain remaining ongoing uses that EPA is regulating in this rulemaking, as described in the following subsections.

#### Plastic Shipping Pallets

Recycled plastics containing decaBDE are used in the manufacturing of plastic shipping pallets by Intelligent Pooling Systems Company LLC (“iGPS”). iGPS provides a pallet rental service using plastic shipping pallets. In order to meet U.S. fire safety standards, the pallets that iGPS originally purchased used a polymeric composite matrix that contains small quantities of decaBDE; decaBDE was only added to this first generation of pallets. iGPS’ business model focuses on the recycling of damaged pallets. Damaged pallets are removed from service and disassembled so that the plastic can be remolded into

<sup>14</sup> EPA used March 8, 2021 as a start date for the Datamyne query, consistent with the compliance date of the January 2021 rule. The September 19, 2022 end date reflects the most recent available information on the date of the query.

replacement pallets. No additional decaBDE is added during the recycling process; the decaBDE that is present in a recycled pallet is due only to the recycled content. In a public comment on the proposed rule, iGPS stated that the pallets from the Company's original pallet fleet containing decaBDE are visually indistinguishable from those that have been newly formed (or reformed) as part of the business' recycling operations. Thus, iGPS cannot distinguish which pallets in its fleet contain decaBDE without performing chemical testing on each pallet (iGPS 2024). iGPS would have to sample its pallets to determine which ones contain decaBDE, these figures would need to be used to calculate the costs of testing all pallets in a multi-million pallet fleet. The foregoing does not include the prohibitive expense of manually labeling and re-labelling shipping pallets. iGPS has previously estimated the pallet labelling requirements EPA has proposed would impose additional costs approaching \$10 million to implement. The additional costs of testing, storage, and movement of pallets alone is greater than the asset value of the fleet of pallets many times over. With the added burden of labelling each pallet, these figures would further skyrocket (iGPS 2024).

Another public commenter, the Institute of Scrap Recycling Industries, Inc. (ISRI), noted that recyclers that receive plastic pallets for recycling are in no position to determine whether an unlabeled pallet contains decaBDE (Institute of Scrap Recycling Industries 2024). iGPS does not apply labels (or replace damaged labels) to its shipping pallets when they pass through a facility. iGPS originally distributed pallets with adhesive labels containing the pallets' serial numbers but moved away from this approach as they became illegible due to the rigorous conditions to which pallets are routinely subjected (iGPS 2024). Embedded radio frequency identification devices (RFID technology) enable the iGPS pallets to be traced and tracked (iGPS 2021).

iGPS relies on a third-party recycler to recycle its pallets in accordance with specific procedures<sup>15</sup>, at one facility, located in the United States. To clean the ambient air of the facility, they use a dual-stage industrial air filtration system comprising a pre-filter which effectively removes particles of 3 microns and greater at up to 70% efficiency, and the main bag filter which captures submicron particles down to 0.3 microns at an efficiency of 95%. They use a closed-loop remanufacturing process to ensure that recycled content from pallets is used only in the production of more pallets, and not diverted for use in manufacturing of other goods (iGPS 2021). PPE for workers involved in the recycling process are safety glasses, gloves, N95 masks, and ear plugs (iGPS 2022).

An independent study provided to the Agency documented that there is no transfer of decaBDE from the pallets to the packaging of goods carried on these platforms (Environ International Corporation 2009); this rule focuses only on the recycling activity (not on use of the pallets).

iGPS is the only specific company confirmed by the EPA to be associated with this use. Therefore, in estimating the number of entities affected by this rule, EPA assumes one company (the unidentified third-party recycler is assumed to operate under iGPS' auspices).

Table 3-5: Business Statistics for Company Associated with Plastic Shipping Pallets				
Company	Parent Company	NAICS	Parent Number of Employees	Revenue (2022\$, Millions USD)
iGPS Logistics LLC	iGPS Logistics LLC	532490 Other Commercial and Industrial Machinery and Equipment Rental and Leasing	60	\$45

<sup>15</sup> See iGPS 2015, General iGPS Pallet Procedure Overview.

**Source:** (Dun & Bradstreet 2022)

### Recycling of DecaBDE-containing Plastic

Historically, decaBDE was widely used in plastics as a general-purpose additive flame retardant. Many plastic products and articles that contain decaBDE are commonly recycled in the United States. High-impact polystyrene (HIPS), polyethylene, polypropylene, polybutylene terephthalate, and unsaturated polyesters were the most common plastics treated with decaBDE (Alaee et al., 2003; BSEF, 2006 as cited in EPA Exposure Assessment of PBDE, 2010, pg. 2-7 and 2-8). Polyethylene plastics are used in the insulation of wire and cables of electrical equipment. Polypropylene plastics are used in communication cables, capacitor films, building cables, pipes, stadium seats, lamp sockets and holders, and kitchen hoods. Polybutylene terephthalate plastics are used as connectors in electrical and electronic equipment. Unsaturated polyesters are used in building and construction materials as reinforced plastic panels.

Recycling includes any activity that attempts to reclaim either decaBDE or the components in which decaBDE is applied or bound. Given the prominence of decaBDE in past years, it is expected to be present in recycled materials. A 2018 study found that 92% of the e-waste samples tested contained decaBDE at concentrations ranging from 1 to 3,310 ppm (Strakova 2018). While these levels are well below the percent at which decaBDE is used intentionally as flame retardant (120,000 ppm for most applications), decaBDE can persist through recycling processes for some time (Weil and Levchik 2016).

The industries listed in Table 3-6 may be associated with recycling of decaBDE-containing plastic from products or articles and decaBDE-containing products or articles made from such recycled plastic, where no new decaBDE is added during the recycling process.

**Table 3-6: Industry Sectors Associated with Recycling of DecaBDE-containing Plastic**

NAICS Code	NAICS Description	Number of firms in NAICS
325991	Custom Compounding of Purchased Resins	340
3261	Plastics Product Manufacturing	7,550
562920	Materials Recovery Facilities	1,004
<b>Total</b>		<b>8,894</b>

**Source:** (U.S. Census Bureau 2020)

### Replacement Parts for Use in Aerospace Vehicles

According to the Aerospace Industry Association (AIA), decaBDE is used as a fire proofing and protective coating on some fixed and/or rotary wing aircraft, and in aircraft interiors materials applications to protect against and suppress fire aboard the aircraft (Aerospace Industries Association (AIA) 2019). Some large aerospace companies, such as Boeing, have already phased decaBDE out of use (U.S. Environmental Protection Agency (EPA) 2017d). AIA stated that it believes that the phase-out of decaBDE from new products in the aerospace industry as a whole would be achieved by 2023 (Aerospace Industries Association (AIA) 2019); the 2021 final rule allows until January 8, 2024 to cease manufacture, processing and distribution in commerce of decaBDE for use in parts installed in and sold as part of new aerospace vehicles, and of the parts to which decaBDE has been added for such vehicles.

However, as EPA stated in the preamble to the 2021 final rule (86 FR 888, January 6, 2021), the decaBDE-containing parts produced for aerospace vehicles before January 2024 may require replacement parts to meet flame-retardancy standards through the end of the service lives of the vehicles. Any transition to alternatives for those replacement parts will require verification to meet these standards. Imposing immediate restrictions on replacement parts for those vehicles could have increased costs and safety concerns, but, without meaningful exposure reductions. Therefore, EPA adopted, in the 2021 final

rule, the compliance deadline of the end of the service lives for aerospace vehicles from the prohibition on the manufacture (including import), processing, and distribution in commerce of decaBDE for use in aerospace replacement parts, and the replacement parts that contain decaBDE.

For the purpose of this rule, replacement parts are those parts designed before January 6, 2021 to replace parts already made with decaBDE. Under the 2021 final rule, EPA does not allow replacement parts containing decaBDE to be manufactured, processed, or distributed in commerce to replace parts that were not previously designed to contain decaBDE.

The rule will affect U.S. workers during the manufacturing and processing of decaBDE-containing replacement parts for use in aerospace vehicles by requiring PPE. EPA is not requiring PPE for distribution in commerce of decaBDE-containing articles nor for processing of aerospace parts to which decaBDE has been added, since the processing and distribution in commerce of these decaBDE-containing articles will result in minimal potential for worker exposure. Given that there is no domestic manufacture of aerospace vehicle replacement parts containing decaBDE (that is, they are all imported), there are no companies and no industry sectors associated with this activity.

The industries listed in Table 3-7 may be associated with import/export of replacement parts for aerospace vehicles.

<b>Table 3-7: Industry Sectors Associated with Replacement Parts for Aerospace Vehicles</b>		
<b>NAICS Code</b>	<b>NAICS Description</b>	<b>Number of firms in NAICS</b>
336412	Aircraft Engine and Engine Parts Manufacturing	321
336413	Other Aircraft Part and Auxiliary Equipment Manufacturing	738
336415	Guided Missile and Space Vehicle Propulsion Unit and Propulsion Unit Parts Manufacturing	17
336419	Other Guided Missile and Space Vehicle Parts and Auxiliary Equipment Manufacturing	31
<b>Total</b>		<b>1,107</b>

**Source:** (U.S. Census Bureau 2020)

### Replacement Parts for Motor Vehicles

The Alliance of Automobile Manufacturers (Auto Alliance) has provided evidence to suggest that decaBDE-containing articles are imported into the United States in the form of automobile replacement parts. A wide array of auto parts have historically contained decaBDE as a flame retardant to meet safety standards. While the Auto Alliance has claimed that no production parts contain decaBDE any longer except for wire and cable assemblies, automakers are required by law to maintain replacement parts for fifteen years after production has ceased. As such, there are likely ongoing imports to support automakers in abiding by these laws (Alliance of Automobile Manufacturers (Auto Alliance) 2018).

This rule affects U.S. workers during the manufacturing and processing of decaBDE-containing replacement parts for use in motor vehicles by requiring PPE. EPA is not requiring PPE for distribution in commerce of decaBDE-containing articles nor for processing of motor vehicle parts to which decaBDE has been added, since the processing and distribution in commerce of these decaBDE-containing articles will result in minimal potential for worker exposure. Given that there is no domestic manufacture of motor vehicle replacement parts containing decaBDE (that is, they are all imported), there are no companies and no industry sectors associated with this activity.

The industries listed in Table 3-8 may be associated with import/export of replacement parts for motor vehicles.

<b>Table 3-8: Industry Sectors Associated with Replacement Parts for Motor Vehicles</b>		
<b>NAICS Code</b>	<b>NAICS Description</b>	<b>Number of firms in NAICS</b>
336211	Motor Vehicle Body Manufacturing	609
336310	Motor Vehicle Gasoline Engine and Engine Parts Manufacturing	656
336320	Motor Vehicle Electrical and Electronic Equipment Manufacturing	528
336390	Other Motor Vehicle Parts Manufacturing	1,090
336991	Motorcycle, Bicycle and Parts Manufacturing	378
336999	All Other Transportation Equipment Manufacturing	389
<b>Total</b>		<b>3,650</b>

#### **Wire and Cable Insulation in Nuclear Power Generation Facilities**

DecaBDE can be used as a flame retardant in the rubber casings of electrical wires and cables. DecaBDE has been used in Class 1E cables, which are qualified to meet industry standards and the Nuclear Regulatory Commission's (NRC) requirements in 10 CFR 50.49, "Environmental qualification of electric equipment important to safety for nuclear power plants," including the Institute of Electrical and Electronics Engineers 383 ("IEEE 383") standard for instrumentation and power cable insulation. Communications with the National Electronic Manufacturer's Association (NEMA) and RSCC Wire and Cable indicate that RSCC is the only remaining user of decaBDE for this application, and that the decaBDE-containing wire and cable is currently only used in wire and cable insulation in nuclear power generation facilities (U.S. Environmental Protection Agency (EPA) 2018d).

Under the 2021 final rule, for any processing and distribution in commerce of decaBDE for use in decaBDE-containing wire and cable insulation, and the decaBDE-containing wire and cable insulation, in nuclear power generation facilities was to be prohibited by January 6, 2023. However, the only known supplier, RSCC, has been permitted to resume these activities for a limited time under a settlement agreement (U.S. Environmental Protection Agency (EPA) 2023a). In addition, this company has already begun transitioning to a decaBDE-free alternative and only requested an extension until April 30, 2024 which EPA expects will be before this rulemaking is finalized (U.S. Environmental Protection Agency (EPA) 2023a). Another company, Prysmian Group, indicated that they have already taken steps to reformulate its products for the nuclear power generation industry to eliminate decaBDE, with some formulations decaBDE-free since 2014 (Prysmian Group North America 2024).

In a public comment on the proposed rule, the Nuclear Energy Institute (NEI) estimated that there may be approximately 450 miles of decaBDE-containing cable and approximately 2,000 decaBDE-containing components installed in each of the 92 units that were in operation at that time (Nuclear Energy Institute 2024). NEI outlined a number of specific reuse practices, including production of new components that incorporate decaBDE-containing wire and cable that has not reached the end of its service life and rewiring of existing components utilizing decaBDE-containing wire and cable that has not reached the end of its service life.

<b>Table 3-9: Business Statistics for Company Associated with Wire and Cable Insulation in Nuclear Power Generation Facilities</b>				
<b>Company</b>	<b>Parent Company</b>	<b>NAICS</b>	<b>Parent Number of Employees</b>	<b>Revenue (2022\$, Millions USD)</b>
RSCC Wire and Cable	Berkshire Hathaway Inc	335921 Fiber Optic Cable Manufacturing	372,000	\$276,094
<b>Source:</b> (Experian 2023)				

### 3.3 Phenol, isopropylated, phosphate (3:1) (PIP (3:1))

#### 3.3.1 Manufacture/Import

Table 3-10 presents the historical U.S. production volume of PIP (3:1) as reported through the IUR and CDR from 1986 to 2020. Overall, national production of PIP (3:1) has trended downward, with a notable drop between 2011 and 2012. For the 2020 CDR submission period, production held steady at between 1 and 10 million pounds.

**Table 3-10: 1986 to 2019 National Production Volume Data for PIP (3:1)**

Year	Non-Confidential Production Volume in Pounds
1986 to 2002	>10M to 50M
2006	10 to > 50 M
2010	12,362,683
2011	14,932,040
2012	3,191,017
2013	2,968,861
2014	5,632,272
2015	5,951,318
2016	1 M to < 10 M
2017	1 M to < 10 M
2018	1 M to < 10 M
2019	1 M to < 10 M

**Note:** M = Million

**Sources:** (U.S. Environmental Protection Agency (EPA) 2010b; U.S. Environmental Protection Agency (EPA) 2017a; U.S. Environmental Protection Agency (EPA) 2020a)

According to the 2020 CDR data, PIP (3:1) was manufactured or imported by nine facilities in the United States from 2016 to 2019. Table 3-11 presents the publicly available information on the PIP 3:1 from the 2020 CDR. The information presented in Table 3-11 may not represent all of the facilities potentially manufacturing or using PIP (3:1); only certain industries and types of facilities are required to report to CDR.<sup>16</sup>

<sup>16</sup> Please refer to Section 3.1 for information on who is required to report to CDR.

**Table 3-11: U.S. Manufacturers and Importers of PIP (3:1)**

Parent Company	Site	Manufacture or Import	Manufactured Volume (2019) (lbs./yr)	Imported Volume (2019) (lbs./yr)	Type of Process or Use	Industrial Sector	Category of Use
ChemSpec, Ltd.	Chemspec, Ltd. 1559 Corporate Woods Pkwy, Suite 150 Uniontown, OH 44685	Import	0	34,392	Processing as a reactant	Plastics Material and Resin Manufacturing	Flame retardant
ICL Specialty Products North America Inc.	ICL-IP America Inc. 11636 Huntington Road Gallipolis Ferry, WV 25515	Manufacture	CBI	0	Processing-incorporation into formulation, mixture, or reaction product	Plastics Material and Resin Manufacturing	Flame retardant
						Transportation Equipment Manufacturing	Hydraulic fluids
Klüber Lubrication North America L.P.	Klüber Lübrication NA LP32 Industrial Drive Londonderry, NH 03053-2008	NR	0	0	NR	NR	NR
Lanxess Corporation	Lanxess Solutions---Shelton 2 Armstrong Rd Shelton, CT 06484	Import	CBI	CBI	Processing-incorporation into formulation, mixture, or reaction product	Petroleum Lubricating Oil and Grease Manufacturing	Lubricating agent
						Plastics Product Manufacturing	Flame retardant
				CBI	Processing-incorporation into article	Furniture and Related Product Manufacturing	Flame retardant
						Other (requires additional information)	Hydraulic fluids
Metals and Additives LLC Dba Omni Oxide	Omni Oxide Indiana Oxide 10665 N St Rd 59 Brazil, IN 47834	Import	0	28,043	Processing-incorporation into formulation, mixture, or reaction product	Plastics Material and Resin Manufacturing	Flame retardant
NYCO America LLC	NYCO America LLC 87 Amlajack Way Shenandoah Industrial Park Newnan, GA 30265	Import	CBI	CBI	Use-non-incorporative activities	Petroleum Lubricating Oil and Grease Manufacturing	Lubricants and lubricant additives

**Table 3-11: U.S. Manufacturers and Importers of PIP (3:1)**

Parent Company	Site	Manufacture or Import	Manufactured Volume (2019) (lbs./yr)	Imported Volume (2019) (lbs./yr)	Type of Process or Use	Industrial Sector	Category of Use
Special Materials Company	Special Materials Company 70 West 40th Street New York, NY 10018	Import	CBI	CBI	Not Known or Reasonably Ascertainable	Not Known or Reasonably Ascertainable	Flame retardant
St. Louis Group	St. Louis Group HQ 8888 Keystone Xing Indianapolis, IN 46240	CBI	CBI	CBI	Processing-incorporation into formulation, mixture, or reaction product	Rubber Product Manufacturing	Flame retardant
						Wood Product Manufacturing	
						Asphalt Paving, Roofing, and Coating Materials Manufacturing	
						Plastics Material and Resin Manufacturing	
						Synthetic Rubber Manufacturing	
						Paint & Coating Manufacturing	
						Plastics Product Manufacturing	
						Construction	
						Transportation Equipment Manufacturing	
						Custom Compounding of Purchased Resins	
Univar Solutions	Chempoint 411 108th Ave NE Bellevue, WA 98004	NR	0	0	NR	NR	NR

**Notes:** CBI = Confidential Business Information; NR = Not reported

For additional importer data, the Datamyne database was queried for records from 2021<sup>17</sup> to September 2022 using “phenol isopropylated phosphate” as a search term (see Table 3-12). Due to the nature of Datamyne data, some shipments containing PIP (3:1) may be excluded due to being categorized under different chemical names or synonyms. There also may be typos in the data that prevent shipment records containing PIP (3:1) from being located. By far, the most significant category of products reported as being imported is PIP (3:1) in vehicles (motor and marine vehicles, and motorcycles), associated with the Suzuki company.

**Table 3-12: U.S. Importers of PIP (3:1), 2021 to 2022<sup>1</sup>**

Consignee Declared (Importer)	Use Category	Number of Shipments	
		March to December 2021	January to September 2022
Interamericana Trading [Freight Management Service]	New and Replacement Parts for Motor Vehicles (Suzuki Motor Corporation)	0	20
Lanxess Solutions US Inc.	Lubricants and Greases (includes shipments of Reolube 140, Reofos 65)	0	4
Livingston International [Customs broker]	Lubricants and Greases (includes shipments of Reolube 140, Reofos 65, Reofos 1800)	14	21
Lubrizol Advance Materials	Lubricants and Greases (includes shipments of Reofos 65)	4	0
McCain International Inc.	New and Replacement Parts for Motor Vehicles (from Suzuki Motorcycles)	0	2
Montgomery Motors Ltd.	New and Replacement Parts for Motor Vehicles (from Suzuki Motor Corporation)	4	6
NYCO America	Aviation Hydraulic Fluid Lubricants and Greases (AVIATION ONLY) (includes Turbonycoil 160)	3	10
Quaker Chemical Corporation	Lubricants and Greases	0	2
Santo Domingo Motors Co. S.A.	New and Replacement Parts for Motor Vehicles (from Suzuki Motors)	1	4
Suttons International N.A. Inc. [Freight Management Service]	Lubricants and Greases (includes shipments of Reolube 140, Reofos 65, Reofos 1800)	4	10
Suzuki Marine USA, LLC	New and Replacement Parts for Motor Vehicles	225	764
Suzuki Motor USA, LLC	New and Replacement Parts for Motor Vehicles	69	197
Not Declared	Unknown	44	13
<b>Total</b>		<b>368</b>	<b>1,053</b>
<b>Notes:</b>			
<sup>1</sup> March 8, 2021 to September 19, 2022			
Datamyne original search results were cleaned to exclude imports of other chemicals besides PIP (3:1).			
<b>Source:</b> (Descartes Datamyne 2023)			

### 3.3.2 Regulated Uses (Processing and Distribution)

PIP (3:1) functions in industry as a flame retardant, plasticizer, anti-compressibility additive, anti-wear additive, or some combination of functions (U.S. Environmental Protection Agency (EPA) 2020b). PIP (3:1) is incorporated into articles, used as a chemical processing or manufacturing aid, and can be

<sup>17</sup> EPA used March 8, 2021 as a start date for the Datamyne query, consistent with the compliance date of the January 2021 rule. The September 19, 2022 end date reflects the most recent available information on the date of the query.

incorporated into formulations, mixtures or reaction products (U.S. Environmental Protection Agency (EPA) 2020b). PIP (3:1) is incorporated into various end-use products across industries and is also used as an additive that can be combined with other formulated products.

PIP (3:1) is marketed as a flame retardant/plasticizer additive by two of the manufacturers identified in Table 3-12, ICL-IP and Lanxess, as follows. The extent that any of these additive products is used in any of the specific uses described below is unknown.

- **Phosflex 31L:** flame retardant/plasticizer by ICL-IP. Used primarily in PVC formulations, may be applied in other resin systems as well (ICL-Industrial Products 2017a)
- **Phosflex 41 L:** flame retardant/plasticizer by ICL-IP. Used primarily in PVC formulations, may be applied in other resin systems as well (ICL-Industrial Products 2010)
- **Reofos 35:** a flame retardant by Lanxess used in plastisols and coated fabrics (LANXESS 2017f)
- **Reofos 65:** flame retardant/plasticizer by Lanxess used primarily in PVC and phenolic resins (Great Lakes Solutions 2010)
- **Reofos 95:** flame retardant by Lanxess for PVC, flexible polyurethanes, cellulosic resins, and synthetic rubber (LANXESS 2017g)
- **Reofos 1800:** flame retardant by Lanxess used in a wide range of polymers, particularly flexible PVC and phenolic resin (Lanxess 2021)

EPA's economic analysis for the January 2021 final rule described the historical uses of PIP (3:1) as well as the uses that were currently ongoing. The 2021 final rule prohibited or limited several of these uses. The current rule addresses the following uses which remain ongoing. Each of these are described in the following subsections.

### **Lubricants and Greases**

PIP (3:1) functions as a lubricant and as a lubricant additive in the petroleum lubricating oil and grease manufacturing sector (U.S. Environmental Protection Agency (EPA) 2017a). The chemical is used for both its anti-wear and lubricant properties (U.S. Environmental Protection Agency (EPA) 2017b) and is included for fire resistance in lubricant and grease products (American Petroleum Institute (API) 2017). The types of products containing the chemical are hydraulic lubricating fluids, gear lubricating oils, and lubricating greases, which are primarily used in industrial machinery, along with servicing aircraft and automobiles (American Petroleum Institute (API) 2017). PIP (3:1) has typically been used in lubricants at a concentration of 0.1 to 3.0% (American Petroleum Institute (API) 2017).

### **Lubricants and Greases Used in Aerospace and Turbines**

PIP (3:1)-containing products for use in lubricants and greases and PIP (3:1)-containing lubricants and greases were excluded from the 2021 final rule. This rule continues to exclude turbine engine and aerospace uses from regulation.

According to Boeing, fire-resistant properties of PIP (3:1) in oils and fluid limit fire degradation of aircraft systems, reducing the frequency at which aircraft parts need to be replaced (Boeing 2019). Aerospace products containing PIP (3:1) also have the challenge of conformance with external government specifications such as DOD military specifications, FAA or NASA standards. Boeing reiterated this in a comment on the proposed rule, contending that chemical substitutes cannot necessarily be implemented by the aerospace industry within an arbitrarily defined time period (Boeing 2024). Eastman also indicated the difficulty in reformulating lubricants and greases in the aerospace industry (Eastman Chemical Company 2024). They noted that after the identification of possible alternatives through extensive research and development activities, product testing must then be performed. Following

that, regulatory approvals as required by the Federal Aviation Association (FAA) and the varied Military Specifications must be met and certified. Finally, Original Equipment Manufacturers (OEM) approvals must be sought through further testing and research before circulation into use. Lanxess and NYCO both reported in the 2020 CDR that they import PIP (3:1) for use in the petroleum lubricating oil and grease manufacturing sector. Lanxess manufactures the PIP (3:1)-containing Durad line of anti-wear and extreme pressure additives (including Durad 110, Durad 150, Durad 220, Durad 300, Durad 310M); these are also marketed for aerospace and other turbine uses, including power-generating turbines such as those used for nuclear and wind energy (NYCO 2020b). These and other aerospace lubrication products are listed in Table 3-13. Nye Lubricant's Rheolube 374A has been discontinued (NYE Lubricants 2023). This rule affects workers involved in the manufacturing and processing of PIP (3:1) for use in lubricants and greases used in aerospace and gas turbines, not the consumers of these products. The companies associated with manufacturing and processing of PIP (3:1) for use in lubricants and greases used in aerospace and turbines are provided in Table 3-14.

**Table 3-13: Aerospace or Turbine Lubricant and Grease Products Containing PIP (3:1)**

Product Name	Product Function	Manufacturer	Reference Source
Castrol AN157	Helicopter Gear Oil	BP	(BP Lubricants USA Inc. 2010)
Durad 110	Fire retardant additive	LANXESS	(Lanxess 2017a)
Durad 150	Flame retardant additive	LANXESS	(Lanxess 2018)
Durad 220	Fire retardant / lubricant additive	LANXESS	(Lanxess 2017b)
Durad 300	Fire retardant / lubricant additive	LANXESS	(Lanxess 2017c)
Durad 310M	Fire retardant / lubricant additive	LANXESS	(Lanxess 2017d)
HALO 157	Engine lubricant in helicopter gearboxes	Eastman	(Eastman Chemical Company 2019)
Syn-O-Ad 9578	Phosphorus Lubricant Additive and Aviation Fluid Base Stock	ICL-IP America Inc.	(ICL-Industrial Products 2017b)
Turbonycoil 160	Lubricant for stationary aeroderivative jet turbine engines	NYCO	(NYCO 2021)
Turbonycoil 600	Lubricating oil for stationary industrial gas turbines	NYCO	(NYCO 2020b)

**Table 3-14: Business Statistics for Company Associated with PIP (3:1) in Lubricants and Greases used in Aerospace and Turbines**

Company	Parent Company	NAICS	Parent Number of Employees	Revenue (2022\$, Millions USD)
BP Lubricants/Castrol	BP America Inc.	324110 Petroleum Refineries4	23,000	\$7,617
Eastman Chemical Company	Eastman Chemical Company	325199 All Other Basic Organic Chemical Manufacturing	14,500	\$10,480
ICL-IP America	ICL Specialty Products North America Inc.	325180 Other Basic Inorganic Chemical Manufacturing	13,000	\$940
LANXESS	Lanxess Services US LLC	424690 Other Chemical and Allied Products Merchant Wholesalers	14,548	\$8,550
NYCO	NYCO Products Co.	324191 Petroleum Lubricating Oil and Grease Manufacturing	80	\$169

**Source:** (Dun & Bradstreet 2022; Experian 2023)

### **Lubricants and Greases Used in Other Industries**

PIP (3:1)-containing lubricant products that EA was able to identify, other than those described in the previous section as being for aerospace use and turbine engines only, include those listed in Table 3-15.

This regulation affects workers involved in the manufacturing and processing of PIP (3:1) for use in lubricants and greases (excluding aerospace use and turbine engines), not the consumers of these products. Based on the information above, the companies associated with manufacturing and processing of PIP (3:1) for use in lubricants and greases (excluding aerospace use and turbine engines) are provided in Table 3-16.

**Table 3-15: Non-Aerospace/Turbine Lubricant and Grease Products Containing PIP (3:1)**

Product Name	Product Function	Manufacturer	Reference Source
AC Smartshot Cool Enhancer	Two catalysts and a lubricating agent to maximize efficiency of air conditioning and refrigeration systems	Cool Air Products	(Cool Air Products 2018)
Airpress 15	Oil for industrial installations and airless systems	Klüber Lubrication	(Klüber Lubrication 2015, 2022a)
Excelene 316	Grinding oil for machining metals	Houghton International, Inc.	(Flywheel Distribution LLC 2022)
Experimental Oil RM190422U	Not available	Nye Lubricants	(NYE Lubricants 2020)
Klüberlub BE 41-1501	Grease for highly-loaded rolling bearings operating at low speeds	Klüber Lubrication	(Klüber Lubrication 2017, 2022b))
Metco S2 Grease	Lubricating grease	Fuchs Lubricants Co.	(Fuchs Lubricants Co. 2021a)
Optigear 1100/100	Gear lubricant	BP Lubricants USA Inc.	(BP Lubricants USA Inc. 2022)
Petamo GHY 133 N	Long-term and high-temperature grease for rolling bearings	Klüber Lubrication	(Klüber Lubrication 2011)
Platinol B 804/3 COW-1	Metalworking lubricant	Walter Surface Technologies	(Walter Surface Technologies 2018)
Renoform 5547 RPX	Metalworking fluid	Fuchs Lubricants Co.	(Fuchs Lubricants Co. 2021b)
Reolube 140	Lubricant for industrial use	Lanxess	(Lanxess 2017e)
Shell Omala S4 WE 320	Gear lubricant (can be used in vehicle replacement parts)	Shell Oil Products US	(Shell Oil Products US 2021)
Stabylan CL 126	Lubricating fluid: high temperature chain oil developed for textile tenter chains	Fuchs Lubricants Co.	(Fuchs Lubricants Co. 2017)
Syn-O-Ad 9578	Anti-wear oil additive	ICL-IP	(ICL-Industrial Products 2017b, 2022)
Tribol CS 1555/32	Compressor lubricant	BP Lubricants USA Inc.	(BP Lubricants USA Inc. 2017)
V32 Vacuum Pump Oil	Synthetic vacuum pump oil	Tire Seal, Inc.	(Tire Seal Inc. 2014)
Variocut G 500	Metalworking fluid	BP Lubricants USA Inc.	(BP Lubricants USA Inc. 2021)
Verkomax SG-2	Lubricating rolling mill bearings (steel or paper industries)	Quaker Houghton	(Quaker Houghton 2020)

**Table 3-16: Business Statistics for Parent Companies Associated with PIP (3:1) in Lubricants and Greases (excluding Aerospace and Turbine Use)**

Company	Parent Company	NAICS	Parent Number of Employees	Revenue (2022\$, Millions USD)
BP Lubricants USA Inc.	BP America Inc.	324110 Petroleum Refineries4	23,000	\$7,617
Cool Air Products	Cool Air Products LLC	333415 Air-Conditioning and Warm Air Heating Equipment and Commercial and Industrial Refrigeration Equipment Manufacturing	10	\$2
Fuchs Lubricants Co.	Fuchs Lubricants Corporation	324191 Petroleum Lubricating Oil and Grease Manufacturing	5,858	\$3,400
Houghton International, Inc.	Quaker Chemical Corporation	324191 Petroleum Lubricating Oil and Grease Manufacturing	4,600	\$1,944
ICL-IP	ICL Specialty Products North America Inc.	325180 Other Basic Inorganic Chemical Manufacturing	13,000	\$940
Klüber Lubrication	Klüber Lubrication NA LP	324191 Petroleum Lubricating Oil and Grease Manufacturing	48,490	\$10,480
Lanxess	Lanxess Services US LLC	424690 Other Chemical and Allied Products Merchant Wholesalers	14,548	\$8,550
Nye Lubricants	Nye Lubricants, Inc.	324191 Petroleum Lubricating Oil and Grease Manufacturing	5,858	\$3,400
Quaker Houghton	Quaker Chemical Corporation	324191 Petroleum Lubricating Oil and Grease Manufacturing	4,600	\$1,944
Shell Oil Products US	Shell Oil Co.	324110 Petroleum Refineries	24,000	\$126,100
Tire Seal, Inc.	BP America Inc.	324110 Petroleum Refineries	23,000	\$7,617
Walter Surface Technologies	Cool Air Products LLC	333415 Air-Conditioning and Warm Air Heating Equipment and Commercial and Industrial Refrigeration Equipment Manufacturing	10	\$2

**Source:** (Dun & Bradstreet 2022; Experian 2023)

### New and Replacement Parts for Motor Vehicles

Automakers are obligated by law<sup>18</sup> and customer requirements to maintain a supply of replacement parts for 15 years or more after production of the automobile has ceased. The Motor & Equipment Manufacturers Association (MEMA) and the Alliance for Automotive Innovation (Auto Innovators) have stated that based on a recent vehicle manufacturer data collection, PIP (3:1) was identified in more than 800 motor vehicle components in International Material Data System (IMDS) record submissions<sup>19</sup> (Motor & Equipment Manufacturers Associates (MEMA) and Auto Innovators 2021). Another industry group, the Auto Alliance, previously found that PIP (3:1) is present in at least 32 production parts and 15 replacement parts (Alliance of Automobile Manufacturers (Auto Alliance) 2018). The Auto Alliance

<sup>18</sup> Fixing America's Surface Transportation (FAST) Act of 2015, Public Law 114-94, § 30120(g)(1), Dec. 4, 2015

<sup>19</sup> According to MEMA and the Auto Innovators, this number is not reflective of total parts in the motor vehicle universe that contain PIP (3:1). Vehicle manufacturers do not include part number information in the data collection query, and therefore, it is not a 1:1 ratio.

indicated that as of February 2018, the industry had no current plans to phase out of PIP (3:1) in the production of U.S. vehicles. Similarly, MEMA and Auto Innovators claim that there is currently no known technically feasible alternative to PIP (3:1) in the motor vehicle industry (Motor & Equipment Manufacturers Associates (MEMA) and Auto Innovators 2021 ).

Under the 2021 final rule, use of PIP (3:1) in both new and replacement parts for *motor vehicles* are excluded from prohibition. In the comment period following the 2021 rule's promulgation [docket identification number EPA-HQ-OPPT-2021-0202], stakeholders revealed that a number of parts and components in heavy machinery could also potentially contain PIP (3:1). These parts, listed in Table 3-17, are very similar (and in some cases identical, according to commenters), to the parts used in on-road motor vehicles. For the purposes of regulation under this rule, this use category now includes heavy machinery such as off-road vehicles (e.g., utility terrain vehicles, all-terrain vehicles, side by sides, snowmobiles, golf carts), motorcycles (including scooters, mopeds, and other two-wheel gas and electric vehicles), agricultural equipment (e.g., tractors, combines), construction equipment (e.g., excavators, bulldozers, cranes), lawn and garden equipment (e.g., riding mowers), forklifts, marine watercraft/boats, and rail and bus transportation vehicles (e.g., train engines, subway rail cars, buses).

During the 2021 comment period, stakeholders listed examples of components that could contain PIP (3:1), given the chemical's known uses; these are summarized in Table 3-17. Stakeholders described that the supply chains for the parts and components in the equipment they manufacture are often several layers deep and that it is difficult and time-consuming to discern the parts that can definitively be identified as containing PIP (3:1); therefore the list in Table 3-17 may be an overestimate of products and articles that actually contain PIP (3:1).

This was reiterated in 2023 comments on the proposed rule. The Alliance for Automotive Manufacturers noted that PIP (3:1) continues to serve many essential uses in thousands of parts and applications (Alliance for Automotive Innovation 2024). Across the parts listed in Table 3-17, PIP (3:1) serves many different functions, including as a flame retardant, elastomer, and lubricant, and as an essential component of some hydraulic fluids.

**Table 3-17: Examples of Components in Motor Vehicles and Heavy Equipment that Potentially Contain PIP (3:1)**

<ul style="list-style-type: none"> <li>adhesives</li> <li>air filters</li> <li>alarm components (including audible alarm resistor)</li> <li>automatic tire inflation equipment</li> <li>body panels</li> <li>circuit boards</li> <li>compressors</li> <li>elastomers</li> <li>electronic components / electrical controllers</li> <li>engine compartment</li> <li>engine emission control systems</li> <li>fabrics and upholstery (seating)</li> <li>fire prevention systems</li> <li>foam</li> <li>gaskets</li> <li>ground cables</li> <li>headlamps / headliners</li> <li>hydraulic fluids</li> <li>hydraulic hoses</li> <li>insulation</li> </ul>	<ul style="list-style-type: none"> <li>lubricants and greases (including permanent magnet or electric motor lubricants)</li> <li>motor gears</li> <li>oils</li> <li>paints &amp; coating applications</li> <li>pre-wired motors</li> <li>PVC (including caps and covers)</li> <li>resin in fiberglass components</li> <li>resistors</li> <li>sealants and coatings</li> <li>sensors (e.g., to measure temperature, pressure, flow rate, etc.)</li> <li>splitters</li> <li>starters</li> <li>switches</li> <li>water pumps</li> <li>windshield wipers</li> <li>wiring</li> <li>wire sleeving / jacketing</li> <li>wiring harnesses</li> </ul>
<p><b>Sources:</b> (Association of Equipment Manufacturers (AEM) 2021; Clark Equipment Company 2021; CNH Industrial America 2021; Industrial Truck Association 2021; Kubota North America Corporation 2021; Motor &amp; Equipment Manufacturers Associates (MEMA) and Auto Innovators 2021 ; National Marine Manufacturers Association 2021; Outdoor Power Equipment Institute 2021; The Motor &amp; Equipment Manufacturers Association 2021; Truck and Engine Manufacturers Association 2021)</p>	

This regulation affects U.S. workers during the manufacturing and processing of PIP (3:1)-containing new and replacement parts for use in motor vehicles as well as companies who use these parts. These types of products and articles are listed in Table 3-17. These types of products and articles typically do not require an SDS (except for hydraulic fluids and lubricants and greases), so EPA is not able to develop a comprehensive list of associated firms. Based on the list of potentially impacted components, industries provided in Table 3-18 (listed by NAICS codes) may be considered makers or consumers of PIP (3:1) in new and replacement parts for motor vehicles and heavy machinery.

**Table 3-18: Industry Sectors Associated with Replacement Parts for Use in Motor Vehicles**

NAICS Code	NAICS Description	Number of firms in NAICS
<b>Makers</b>		
325211	Plastics Material and Resin Manufacturing	847
325991	Custom Compounding of Purchased Resins	340
326199	All Other Plastics Product Manufacturing	4,857
336211	Motor Vehicle Body Manufacturing	609
336310	Motor Vehicle Gasoline Engine and Engine Parts Manufacturing	656
336320	Motor Vehicle Electrical and Electronic Equipment Manufacturing	528
336390	Other Motor Vehicle Parts Manufacturing	1,090
336991	Motorcycle, Bicycle and Parts Manufacturing	378
336999	All Other Transportation Equipment Manufacturing	389
<b>Total</b>		<b>9,694</b>
<b>Consumers</b>		

<b>Table 3-18: Industry Sectors Associated with Replacement Parts for Use in Motor Vehicles</b>		
<b>NAICS Code</b>	<b>NAICS Description</b>	<b>Number of firms in NAICS</b>
333111	Farm Machinery and Equipment Manufacturing	1,014
333112	Lawn and Garden Tractor and Home Lawn and Garden Equipment Manufacturing	147
333120	Construction Machinery Manufacturing	625
333131	Mining Machinery and Equipment Manufacturing	223
333924	Industrial Truck, Tractor, Trailer, and Stacker Machinery Manufacturing	323
333998	All Other Miscellaneous General Purpose Machinery Manufacturing	1,380
334290	Other Communications Equipment Manufacturing	317
336110	Automobile and Light Duty Motor Vehicle Manufacturing	198
336120	Heavy Duty Truck Manufacturing	76
336320	Motor Vehicle Electrical and Electronic Equipment Manufacturing	528
336612	Boat Building	837
336991	Motorcycle, Bicycle and Parts Manufacturing	378
336999	All Other Transportation Equipment Manufacturing	389
<b>Total</b>		<b>6,435</b>

**Source:** (U.S. Census Bureau 2020)

#### New and Replacement Parts for Aerospace Vehicles

PIP (3:1) is also used in aerospace vehicles for its flame-retardant properties, anti-wear, and, in some formulations, for enhancement of load carrying capability of materials and resistance to compressibility (Boeing 2021). Under the current regulation, new and replacement parts for aerospace vehicles are excluded from prohibition.

The Aerospace Industries Association (AIA) members notified EPA that PIP (3:1) is found in articles such as electronics that are manufactured by the aerospace sector, and that it is also found in formulated products – including epoxy and polyester coatings, resins, masking agents, potting compounds and laminates – which conform to product specifications such as for moisture and flammability and are used by the aerospace and defense industry for the development, production, and servicing of industry products (Aerospace Industries Association (AIA) 2019). Products used in the aerospace industry have highly specified requirements for safety and performance standards. Specific components that may contain PIP (3:1), as identified by commenters, are listed in Table 3-19.

**Table 3-19: Examples of Components in New and Replacement Parts for Aerospace Industry that Potentially Contain PIP (3:1)**

<ul style="list-style-type: none"> <li>cable sleeves</li> <li>casings</li> <li>circuit board materials and circuit card assemblies, including in housings and components in storage devices</li> <li>clamps</li> <li>commercial and industrial apparatus</li> <li>condenser covers</li> <li>connection cables</li> <li>electronic equipment</li> <li>engine oils (including oils for auxiliary power units)</li> <li>fuse housings</li> <li>ground cables</li> <li>harnesses</li> <li>HDMI cables</li> <li>hydraulic fluids</li> <li>insulation covers/sleeves used in conjunction with internal and external cables and wirings</li> </ul>	<ul style="list-style-type: none"> <li>internal tapes, gaskets, and sheets that are used to shield/protect from electromagnetic waves and for other safety measures</li> <li>landing gear fluids</li> <li>manufactured articles to which PIP 3:1-containing adhesives and sealants have been applied during testing or assembly</li> <li>manufacturing equipment</li> <li>power supplies (and power supply cords)</li> <li>PVC cables</li> <li>specialty clamps and connections that have insulating and anti-vibration properties</li> <li>switch cable</li> <li>tapes and the products to which such adhesives and tapes have been applied</li> <li>terminal covers</li> <li>tubes</li> <li>USB cables</li> </ul>
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**Source:** (Aerospace Industries Association (AIA) 2019; Boeing 2021)

This regulation affects U.S. workers during the manufacturing and processing of PIP (3:1)-containing new and replacement parts for use in aerospace vehicles as well as companies who use these parts. The types of products and articles listed in Table 3-19 typically do not require an SDS, so EPA is not able to develop a comprehensive list of associated firms. Based on the list of potentially impacted components, industries provided in Table 3-20 (listed by NAICS codes) may be considered makers or consumers of PIP (3:1) in new and replacement parts for aerospace vehicles.

**Table 3-20: Industry Sectors Associated with Replacement Parts for Use in Aerospace Vehicles**

NAICS Code	NAICS Description	Number of firms in NAICS
<b>Makers</b>		
325211	Plastics Material and Resin Manufacturing	847
325613	Surface Active Agent Manufacturing	383
325991	Custom Compounding of Purchased Resins	340
336412	Aircraft Engine and Engine Parts Manufacturing	321
336413	Other Aircraft Part and Auxiliary Equipment Manufacturing <sup>7</sup>	738
336415	Guided Missile and Space Vehicle Propulsion Unit and Propulsion Unit Parts Manufacturing	17
336419	Other Guided Missile and Space Vehicle Parts and Auxiliary Equipment Manufacturing	31
<b>Total</b>		<b>2,677</b>
<b>Consumers</b>		
336411	Aircraft Manufacturing	295
336414	Guided Missile and Space Vehicle Manufacturing	29
<b>Total</b>		<b>324</b>

**Source:** (U.S. Census Bureau 2020)

### Wire Harnesses and Electric Circuit Boards

Wire harnesses and electric circuit boards are articles that may contain PIP (3:1) as a flame retardant. A wire harness is a system of insulated conducting wires (a collection of individually sheathed wires) bound together with insulating materials to form a unit, used in the electrical system of a machine, such as a motor vehicle or washing machine that are bundled together to form a unit. This unit of wires provides electrical connectivity while keeping electrical components organized (Regole 2021). EPA interprets wire harness to include a broad class of articles, including but not limited to terminal and fuse covers; cable sleeves; casings; connectors; tapes; and gaskets. Wire harnesses are used in a variety of applications, from defense to aerospace and motor vehicle applications, to medical instrumentation and more. In these articles, PIP (3:1) is used as a plasticizer and flame retardant. EPA also understands that PIP (3:1) use in electronic component manufacturing includes the use of PIP (3:1) in circuit boards and printed circuit connectors as well as the use of PIP (3:1) products as adhesives for encapsulation of capacitors in electronics components and as resins in overmolding, dip molding, insert molding applications, or conformal coatings.

EPA is not aware of a replacement for PIP (3:1) for use in wire harnesses and circuit boards that combines properties as a plasticizer, a fire retardant, an anti-wear additive, and an insulator. Hence, replacing PIP (3:1) for these will not be a direct substitute but might require multiple chemicals. EPA acknowledges the process of replacing PIP (3:1) with separate chemicals for each function would require an un-estimable amount of time to certify new end-use products (Boeing 2019; Association of Equipment Manufacturers (AEM) 2021). EPA also acknowledges that it is unclear if a technically and economically feasible alternative for PIP (3:1) exist that would meet the voluntary and regulatory safety standards these articles meet. EPA and commenters are not aware of industry efforts to identify or qualify an alternative. For these reasons, EPA has determined that it is impracticable to prohibit the processing and distribution of PIP (3:1) for use in wire harnesses and circuit boards.

This rule affects U.S. workers during the manufacturing and processing of PIP (3:1)-containing wire harnessing and electric circuit boards. Industries provided in Table 3-21 (listed by NAICS codes) may be considered makers wire harnessing and electric circuit boards that may contain PIP (3:1).

**Table 3-21: Industry Sectors Associated with Wire Harnesses and Electric Circuit Boards**

NAICS Code	NAICS Description	Number of firms in NAICS
<b>Makers</b>		
325211	Plastics Material and Resin Manufacturing	847
325991	Custom Compounding of Purchased Resins	340
334412	Bare Printed Circuit Board Manufacturing	406
334418	Printed Circuit Assembly (Electronic Assembly) Manufacturing	722
335931	Current-Carrying Wiring Device Manufacturing	355
<b>Total</b>		<b>2,670</b>
<b>Source:</b> (U.S. Census Bureau 2020)		

### Marine Antifouling Coatings

PIP (3:1) is used as a plasticizer in the formulation and is an inert ingredient under FIFRA. PIP (3:1) is used as a plasticizer in the paint and coating manufacturing sector (U.S. Environmental Protection Agency (EPA) 2017a) where the chemical is found in boat antifouling products. Antifouling paint is utilized to prevent biofouling—the accumulation of microorganisms, plants, algae, or animals on wetted surfaces—on the hull of boats.

According to the 2021 final rule at § 751.407(a)(1), this use of PIP (3:1) has been prohibited since March 8, 2021. PIP (3:1)'s use in this capacity was unknown to the EPA at the time the rule was promulgated. In discussion with the U.S. Navy, they indicated that this antifouling paint falls under the "mission critical" category because hull corrosion on ships can have significant impacts on ship performance. The U.S. Navy also indicated that it would need five years to develop a suitable alternative formulation and undergo the FIFRA approval process. Because no technically feasible alternative is currently available for this use, EPA considers it impracticable to continue prohibiting the processing and distribution of PIP (3:1) for use in this marine antifouling coating while an alternative is being developed. EPA believes there are suitable alternatives for commercial users, and so is limiting this exclusion to products that meet Department of Defense specification requirements.

In the 2016 CDR, International Paint, LLC (parent company Akzo Nobel) reported use of PIP (3:1) at two different sites as plasticizers in the paint and coating manufacturing sector (U.S. Environmental Protection Agency (EPA) 2017a). EPA identified two International Paint boat antifouling products containing PIP (3:1): Interspeed and Micron Extra Blue Antifouling (Akzo Nobel 2017).

<b>Table 3-22: Business Statistics for Company Associated with Marine Antifouling Coatings</b>				
<b>Company</b>	<b>Parent Company</b>	<b>NAICS</b>	<b>Parent Number of Employees</b>	<b>Revenue (2022\$, Millions USD)</b>
International Paint	Akzo Nobel Inc.	325510 Paint and Coating Manufacturing	11,000	\$16,761

### Articles Used in Manufacturing Equipment, including Semiconductors, Electronics, HVACR, Water Heating, and Power Generating Equipment

The Japan Machine Tool Builders' Association (JMTBA) reported to EPA that there is widespread use of PIP (3:1) throughout the manufacturing equipment (machine tool) supply chain (Japan Machine Tool Builders' Association 2021). The Association for Manufacturing Technology stated that a regulatory action limiting the use of PIP (3:1) would affect the machine tool portion of the manufacturing equipment market, as well as products such as consumables, cutting tools, advanced automation, and materials handling (Association for Manufacturing Technology 2021). According to the National Association of Manufacturers, PIP (3:1) is associated with manufacturing a wide range of products, including heating, ventilation and air conditioning systems, refrigeration equipment, life sciences and biomedical equipment, and electrical generation and transmission equipment (National Association of Manufacturers 2021). JMTBA further noted that machine tools are essential for producing products in the automotive, aerospace, military, food, pharmaceutical and medical, agriculture, energy, logistics and construction industries (Japan Machine Tool Builders' Association 2021).

PIP (3:1) used in manufacturing equipment for a variety of industries. This includes agricultural machinery (Japan Agricultural Machinery Manufacturers Association 2024), outdoor power equipment

(Outdoor Power Equipment Institute 2024), consumer technology (Add reference), automated manufacturing (Association for Advancing Automation (A3) 2024), and manufacturing equipment (Add reference). One public commenter speculated that more than 50 percent of U.S. capacity to manufacture could be idled if manufacturers lose access to PIP (3:1)-containing replacement parts (Add reference).

PIP (3:1) is also found in the supply chain for semiconductor-related manufacturing equipment, as well as semiconductor fabrication facilities' support equipment and infrastructure, such as laboratory, substrate and device (e.g., die) preparation, and assembly and test operations, including advanced packaging (SEMI 2021). In a comment on the proposed rule, the Semiconductor Industry Association (SIA) noted that tools can contain tens of thousands of parts, and each of these individual parts are highly engineered articles (Semiconductor Industry Association (SIA) 2024).

Articles in these industries often have supply chains that are complex and multi-layered. One public commenter states that electronic finished goods manufacturers have anywhere from 2,500 to upwards of well over 5,000 suppliers (Consumer Technology Association 2024). Each of those suppliers may provide the components that go into upwards of 5,000 finished goods on average. This translates to upwards of 100,000 or more individual components that go into those finished goods sourced from various suppliers.

**Table 3-23: Examples of Components and Equipment Used in Semiconductor Industry that Potentially Contain PIP (3:1)**

Components	Equipment
<ul style="list-style-type: none"><li>• adhesive</li><li>• grease</li><li>• wire terminal lugs</li><li>• dust covers</li><li>• wire cover repair film</li><li>• a Bayonet Neill-Concelman (BNC) cover</li><li>• filter</li><li>• cable assembly in a PVC boot</li></ul>	<ul style="list-style-type: none"><li>• coater/developer system</li><li>• etch system</li><li>• surface preparation system</li><li>• deposition system</li><li>• test system</li><li>• wafer bonder/debonder</li><li>• SiC Epitaxial CVD system</li><li>• mask writer - equipment used for photomask patterning</li></ul>

Source: (SEMI 2021)

This rule affects U.S. workers during the manufacturing and processing of PIP (3:1)-containing articles used in the manufacturing equipment and semiconductor industries. The types of products described above typically do not require SDS, and EPA is not able to develop a comprehensive list of associated firms that make these articles. Industries provided in Table 3-24 (listed by NAICS codes) may be considered makers of articles used in the manufacturing equipment and semiconductor industry that may contain PIP (3:1). Because the flame-retardant additive is added to the raw polymers during the plastic manufacturing process, EPA believes only workers in these sectors (in Table 3-24) would come into contact with the raw PIP (3:1). Workers in companies that assemble the manufacturing equipment would not directly handle PIP (3:1).

**Table 3-24: Industry Sectors Associated with Articles Used in Manufacturing Equipment and in the Semiconductor Industry**

NAICS Code	NAICS Description	Number of firms in NAICS
<b>Makers</b>		
325211	Plastics Material and Resin Manufacturing	847
325991	Custom Compounding of Purchased Resins	340
333242	Semiconductor Machinery Manufacturing	153
334413	Semiconductor and Related Device Manufacturing	715
<b>Total</b>		2,055
<b>Source:</b> (U.S. Census Bureau 2020)		

The final rule also affects U.S. workers during the manufacturing and processing of PIP (3:1)-containing articles used in the other types of manufacturing, including electronics, HVACR, water heating, and power generating equipment. Several CTA, IPC and ITI member companies have identified the use of PIP (3:1) in the supply chain of electronic components and finished goods (Consumer Technology Association 2024). This includes the presence of PIP (3:1) in components that may have utility in dozens of electronic equipment applications including aerospace, automotive, defense, heavy equipment, home appliances and medical equipment as well as traditional electronic devices. Some companies have indicated that they have been receiving updated information from their supply chains regarding the presence of PIP (3:1) while other companies are may still be coordinating with their supply chain and awaiting confirmation of the presence of PIP (3:1) or its absence.

Below is a non-exhaustive list of known components as well as electronics finished goods where the use of PIP (3:1) has been confirmed:

- Components: Insulation covers / sleeves and other components used in conjunction with internal and external cables (e.g., PVC cables, ground cables, and switch intel cables) and wirings.
  - Includes:
    - Terminal covers
    - Fuse covers
    - Cable sleeves
    - Tubes
    - Casings
    - Harnesses
    - Clamps used with cables
    - Float switch
    - Connectors (housing)
- Internal and external cables including but not limited to power cables, HDMI cables, connection cables, USB cables, etc.
- Components used to shield / protect from electromagnetic waves in conjunction with circuit boards and other components inside electronic devices. Includes:
  - Condenser covers
  - Internal tapes
  - Gaskets
  - Sheets
- Components used for the electronic designs of semiconductors
- Electronic drive units
- Adhesives / Sealants (e.g. epoxy used for encapsulation of capacitors)
- Finished Goods: Televisions
- Desktop PCs

- Blue-ray disc recorders / players
- Professional video monitors
- Displays
- Broadcast equipment
- Projectors
- Portable speakers and audio devices

Additionally, companies may produce finished goods outside of the traditional electronics category that may

- Camcorders
- Professional and consumer cameras
- Electronic microscopes
- Audio / stereo equipment and home theater equipment (e.g., audiovisual receivers, speakers)
- Professional audio / sound reinforcement equipment (e.g., digital mixers, amplifiers)
- Musical instruments (e.g., digital pianos, electric guitars, portable keyboards) as well as sound recording and reproduction technologies
- Radiation detectors
- Laser market sensors
- Office imaging equipment
- Professional monitoring and control instruments

Table 3-25 (listed by NAICS codes) may be considered consumers of articles used in the manufacturing electronics, HVACR, water heating, and power generating equipment that may contain PIP (3:1).

**Table 3-25: Industry Sectors Associated with Articles Used in Manufacturing Electronics, HVACR, Water Heating, and Power Generating Equipment Industry**

NAICS Code	NAICS Description	Number of firms in NAICS
<b>Makers</b>		
333415	Air-Conditioning and Warm Air Heating Equipment and Commercial and Industrial Refrigeration Equipment Manufacturing	685
335999	All Other Miscellaneous Electrical Equipment and Component Manufacturing	722
333998	All Other Miscellaneous General Purpose Machinery Manufacturing	0
336999	All Other Transportation Equipment Manufacturing	389
336612	Boat Building	837
334112	Computer Storage Device Manufacturing	79
334118	Computer Terminal and Other Computer Peripheral Equipment Manufacturing	436
334111	Electronic Computer Manufacturing	304
334417	Electronic Connector Manufacturing	157
333111	Farm Machinery and Equipment Manufacturing	1,014
333414	Heating Equipment (except Warm Air Furnaces) Manufacturing	339
333413	Industrial and Commercial Fan and Blower and Air Purification Equipment Manufacturing	406
333924	Industrial Truck, Tractor, Trailer, and Stacker Machinery Manufacturing	323
333112	Lawn and Garden Tractor and Home Lawn and Garden Equipment Manufacturing	147
335220	Major Household Appliance Manufacturing	128
333613	Mechanical Power Transmission Equipment Manufacturing	190
334419	Other Electronic Component Manufacturing	989
333618	Other Engine Equipment Manufacturing	241
336611	Ship Building and Repairing	430
335210	Small Electrical Appliance Manufacturing	158
339920	Sporting and Athletic Goods Manufacturing	1,552
335313	Switchgear and Switchboard Apparatus Manufacturing	403
336214	Travel Trailer and Camper Manufacturing	562
<b>Total</b>		<b>10,491</b>
<b>Source:</b> (U.S. Census Bureau 2020)		

### Cyanoacrylate Adhesives

Henkel uses PIP (3:1) as an intermediate processing aid in the production of cyanoacrylate (CA) monomers (Henkel Corporation 2019). These CA monomers are then formulated into CA adhesives used in consumer products such as “superglues.” The PIP (3:1) is either consumed during the production process or collected as waste and drummed for incineration (Henkel Corporation 2019). Henkel’s production process with respect to using PIP (3:1) as an intermediate processing aid is carried out in an automated batch distillation plant and in a well-ventilated closed system. Henkel also uses protective equipment and engineering controls to curb worker exposure, examples of which are not limited to: gloves, protective aprons, local exhaust ventilation, and general ventilation (Henkel Corporation 2019). Henkel also provides workers with APF 50 respirators. Henkel attests that employing PIP (3:1) as an intermediate processing aid provides unique benefits to the production process. These include higher production yields, reduced need for solvent clean up, and additional product benefits such as strength, cure speed and shelf life (Henkel Corporation 2019).

Under the 2021 regulation, use of PIP (3:1) as an intermediate in a closed system to produce cyanoacrylate adhesives was excluded from prohibition (see 40 CFR § 751.407(b)(1)(iv)).

Henkel is the only known company associated with this use. Therefore, in estimating the number of

entities affected by the rule, EPA assumes one company.

<b>Table 3-26: Business Statistics for Company Associated with Cyanoacrylate Adhesives</b>				
<b>Company</b>	<b>Parent Company</b>	<b>NAICS</b>	<b>Parent Number of Employees</b>	<b>Revenue (2022\$, Millions USD)</b>
Henkel	Henkel Corp.	325520 Adhesive Manufacturing	4,001	\$2,400
<b>Source:</b> Experian 2023				

For the use of PIP (3:1) in the manufacturing of cyanoacrylate adhesives, EPA is requiring that workers be provided with a respirator at least as protective as a NIOSH-approved APF 50 purifying respirator and gloves that are chemically resistant to PIP (3:1) with activity-specific training where dermal contact with PIP (3:1) is possible. According to industry stakeholders, this level of protection is industry standard for the manufacturing of cyanoacrylate adhesives.

#### **Engine Filters for Locomotive and Marine Applications**

Daikin Industries Ltd.'s subsidiary, AAF Flanders, processes PIP (3:1) to make specialized air filters that use PIP (3:1) in a gel (Daikin Industries 2019). The specific products, AmerKleen® 1200 and 2500 cartridge air filters and housing assemblies, function as engine filters in diesel locomotives, as well as energy delivery generators used in offshore marine generators and pipeline generators (Daikin Industries 2019).

In locomotive diesel engine filters, the PIP (3:1) air filters are used to clean the combustion air intake to large heavy-duty industrial diesel engines. This prevents abrasive particles from entering the engines, which can cause premature wear and damage to engines (Daikin Industries 2019). In marine settings, including in ocean vessels and in platform electrical power generation, the PIP (3:1) air filters are used to clean the combustion air intake to large heavy-duty industrial diesel engines. This prevents abrasive particles from entering the engines and causing premature wear and damage to engines that are mission-critical to maintain safe operations in severe and remote locations (Daikin Industries 2019). In these air filters, PIP (3:1) serves to provide fire protection, freezing temperature protection, and sloughing protection (Daikin Industries 2019).

Under the 2021 regulation, use of PIP (3:1) in specialized engine filters for locomotive and marine applications was excluded from prohibition (see 40 CFR § 751.407(b)(1)(v)). In response to EPA's 2023 Nprm removing the exclusion, the National Marine Manufacturers Association (NMMA) indicated that the nature of material changes in the recreational marine industry is complex and time-consuming. They, along with other commenters, requested that the Agency extend the phase-in timeframe for the processing and distribution of PIP (3:1) in lubricants and greases for new and replacement parts, in order to provide manufacturers with adequate time to research, develop, and implement alternative materials without compromising the quality and reliability of marine products (National Marine Manufacturers Association 2024). Recreational boats have a very long, useful life period of 30 to 50 years, so it is crucial to ensure that any alternative materials meet the stringent performance and safety standards necessary for harsh marine applications.

AAF Flanders is the only known company associated with this use. Therefore, in estimating the number of entities affected by the rule, EPA assumes one company.

<b>Table 3-27: Business Statistics for Company Associated with Engine Filters for Locomotive and Marine Applications</b>				
<b>Company</b>	<b>Parent Company</b>	<b>NAICS</b>	<b>Parent Number of Employees</b>	<b>Revenue (2022\$, Millions USD)</b>
AAF Flanders	Daikin Industries Ltd.	423840 Industrial Supplies Merchant Wholesalers	84,870	\$23,520
<b>Source:</b> (Dun & Bradstreet 2022)				

For the use of PIP (3:1) in the manufacturing of certain engine filters, EPA is requiring that workers be provided half or full respirators, and gloves that are chemically resistant to PIP (3:1) with activity-specific training where dermal contact with PIP (3:1) is possible. According to stakeholders (Daikin Industries 2019), this level of protection is used as industry standard practice, in part because of the presence of formaldehyde in the engine filter manufacturing process.

#### **Hydraulic Fluid for Aerospace Industry or to Meet Military Specifications**

Aircraft use hydraulic fluids to power onboard equipment. Within the hydraulic fluid, PIP (3:1) helps with fire resistance and in achieving the appropriate bulk modulus (stiffness) of the fluid (U.S. Environmental Protection Agency (EPA) 2018b). Commercial airlines and military aircraft manufacturers are both consumers of aviation hydraulic fluid that contains PIP (3:1) (Akin Gump Strauss Hauer & Feld LLP (Akin Gump) 2017; Exxon Mobil 2017).

PIP (3:1)-containing hydraulic fluids either for the aerospace industry or to meet military specifications for safety and performance where no alternative chemical is available that meets U.S. Department of Defense specification requirements are exempted from prohibition under the 2021 regulation (40 CFR 751.407(b)(1)(i)).

Airbus uses four hydraulic fluid products: HyJet IV A+ and HyJet V by Exxon Mobil and Skydrol PE-5 and Skydrol LD-4 by Eastman. All except Skydrol LD-4 contain PIP (3:1), and this product does not meet technical specification requirements for aircraft certification and airworthiness purposes for 5,000 PSI systems (Beyderman and Goessing 2019). Airbus aircrafts use hydraulic fluids for hydraulic power generation and for distribution to hydraulic systems such as landing gear, flight controls, cargo doors, the engine thrust reverser, and the emergency electrical system.

Boeing uses the product Skydrol PE-5 in all airplanes other than their 787 aircraft model, for which Boeing uses HyJet V (Boeing 2019). Both Skydrol PE-5 and HyJet V contain PIP (3:1). According to Boeing, the three aircraft hydraulic fluids that do not contain PIP (3:1)—Skydrol 5, Skydrol 500-B4, and Skydrol LD-4—are all unusable for separable reasons: Skydrol 5 testing is still underway and does not have universal airframe manufacturer approval; Skydrol 500-B4 cause degradation of elastomer materials; and Skydrol LD-4 causes wear of internal components and there was a rapid increase in the rate of internal fluid leakage during endurance testing (Boeing 2019). Boeing also noted that the negative effects Skydrol LD-4 causes occur in hydraulic systems with a pressure of 3,000 PSI or more (Boeing 2019).

NYCO manufactures Hydraunycoil FH 19, petroleum-based hydraulic fluid that is intended primarily for use on ordnance equipment such as recoil systems and hydraulic systems for rotating weapon or aiming devices on Navy vessels (NYCO 2020a).

This regulation affects workers involved in the manufacturing and processing of PIP (3:1) for use in aviation hydraulic fluid, not the consumers. Based on the information above, the companies associated

with manufacturing and processing of PIP (3:1) for use in aviation hydraulic fluid are provided in Table 3-28.

<b>Table 3-28: Business Statistics for Company Associated with PIP (3:1) in Hydraulic Fluid for the Aerospace Industry or to Meet Military Specifications</b>				
<b>Company</b>	<b>Parent Company</b>	<b>NAICS</b>	<b>Parent Number of Employees</b>	<b>Revenue (2022\$, Millions USD)</b>
Eastman Chemical Company	Eastman Chemical Company	325199 All Other Basic Organic Chemical Manufacturing	14,500	\$10,480
Exxon Mobil	Exxon Mobil Corporation	324110 Petroleum Refineries	62,000	\$413,680
ICL-IP America	ICL Specialty Products North America Inc.	325180 Other Basic Inorganic Chemical Manufacturing	13,000	\$990
Lanxess	Lanxess Services US LLC	424690 Other Chemical and Allied Products Merchant Wholesalers	14,548	\$8,550
NYCO	NYCO Products Co.	324191 Petroleum Lubricating Oil and Grease Manufacturing	80	\$169

**Source:** (Dun & Bradstreet 2022; Experian 2023)

### 3.4 Summary

As described in the sections above, the number of companies affected by the regulatory options are determined either by number of identified companies, when this is possible, or by number of companies in the affected industry sectors (NAICS). Numbers of companies determined by NAICS are likely to be overestimates, as not all companies within a sector will likely be using or making products or articles containing the regulated chemical. The estimated number of companies associated with the regulation of decaBDE and PIP (3:1) are provided in Table 3-29 for the final option, and Table 3-30 for the alternative option. In total, this rulemaking may affect approximately 26,800 companies under the final option.

**Table 3-29: Estimated Number of Companies Affected by the Final Rule (Final Option)**

Use	Basis	Number of Companies
<b>DecaBDE</b>		
Plastic Shipping Pallets	Identified Companies	1
Replacement Parts for Aerospace Vehicles (makers)	NAICS	0
Replacement Parts for Motor Vehicles (makers)	NAICS	0
Wire and Cable Insulation	Identified Companies	1
<b>All DecaBDE</b>		<b>2</b>
<b>PIP (3:1)</b>		
Lubricants and Greases (except Aerospace and Turbine) (makers)	Identified Companies	5
Lubricants & Greases (Aerospace) (makers)	Identified Companies	11
New and Replacement Parts for Motor Vehicles (consumers)	NAICS	4,562
New and Replacement Parts for Motor Vehicles (makers)	NAICS	8,091
New and Replacement Parts for Aerospace Vehicles (consumers)	NAICS	324
New and Replacement Parts for Aerospace Vehicles (makers)	NAICS	1,787
Wire Harnesses and Electric circuit Boards (makers)	NAICS	1,780
Marine Antifouling Coatings	Identified Companies	1
Articles Used in Manufacturing Equipment, including semiconductor, Electronic, HVACR, Water Heating, and Power Generating Industry (makers)	NAICS	1,165
Articles Used in Manufacturing Equipment, including semiconductor, Electronic, HVACR, Water Heating, and Power Generating Industry (consumers)	NAICS	9,071
Engine Filters for Locomotive and Marine Applications	Identified Companies	1
Cyanoacrylate Adhesives <sup>1</sup>	Identified Companies	0
Aviation Hydraulic Fluid (makers)	Identified Companies	5
<b>All PIP (3:1)</b>		<b>26,803</b>
<b>Total</b>		<b>26,805</b>
<sup>1</sup> Henkel is not included since they use PIP (3:1) in a closed-loop system in the baseline.		
<b>Note:</b> Affected entities have been adjusted down proportionately for PIP (3:1) so as not to include double counting. Totals may not sum due to rounding.		

**Table 3-30: Likely Number of Companies Affected by the Final Rule (Alternative Option)**

Uses	Basis	Number of Companies
<b>DecaBDE</b>		
Other DecaBDE-containing Plastic	NAICS	8,894
<b>All DecaBDE Uses</b>		<b>8,894</b>
<b>PIP (3:1)</b>		
Lubricants and Greases (except Aerospace and Turbine) (makers)	Identified Companies	5
Lubricants & Greases (Aerospace) (makers)	Identified Companies	11
Wire Harnesses and Electric circuit Boards (makers)	NAICS	2,077
Articles Used in Manufacturing Equipment and Semiconductor Industry (makers)	NAICS	1,462
Articles Used in Manufacturing Equipment and Semiconductor Industry (consumers)	NAICS	10,491
<b>All PIP (3:1) Uses</b>		<b>14,045</b>
<b>Total</b>		<b>22,939</b>
<b>Note:</b> Affected entities have been adjusted down proportionately for PIP (3:1) so as not to include double counting. Totals may not sum due to rounding.		

## 4. Cost of the Rule to Industry

### 4.1 General Methodology

In general, costs of the final rule were estimated based on the assumption that costs to manufacturers and processors addressed in this analysis include:

- **Rule familiarization costs** (Section 4.2). Costs incurred by all regulated entities.
- **Prohibition costs** (Section 4.3). Costs that may result from the need to determine whether components of products may contain the regulated chemical (consumers) and to reformulate products or components so that they do not contain the prohibited substance (makers).
- **Worker Protection Costs** (Section 4.4). Costs associated with providing workers with the required personal protective equipment (e.g., respirators, and gloves).
- **Signage Costs** (Section 4.5). Costs incurred for firms to place a sign in the location where the chemical is being used.
- **Export Notification Costs** (Section 4.6). These costs include the cost to the exporter of compiling a list of their products that are subject to TSCA Section 12(b) requirements, writing or revising an export notification letter to EPA, checking the outgoing shipments, and sending the notification letters with the associated shipping costs.
- **Engineering Controls** (Section 4.7) EPA is requiring engineering controls for the use of PIP (3:1) in the manufacturing of cyanoacrylate adhesives. However, EPA believes that affected companies have already implemented the required controls, and therefore no incremental costs will be incurred.
- **Labeling Costs** (Section 4.8). Costs incurred when a product or article must be labeled to indicate that it contains the regulated chemical.
- **Costs to Prevent Releases** (Section 4.9.1). Costs associated with instituting engineering controls aimed at reducing or eliminating environmental releases of the regulated chemicals.

Section 4.9 also provides further discussion of unquantified costs and uncertainties in the cost analysis. The total quantified costs to industry are presented in Section 4.10, and EPA costs to implement the final rule are estimated in Section 4.11.

#### 4.1.1 Time Horizon for Analysis and Annualization

In order to select an appropriate time horizon (number of years) for analysis in this Economic Analysis, it is important to select a period sufficiently long enough to capture the important effects of the costs, however, one that is not too long that it adds unnecessary uncertainty.

EPA's *Guidelines for Preparing Economic Analyses* (U.S. Environmental Protection Agency (EPA) 2014b) recommends that "the time horizon should be long enough that the net benefits for all future years (beyond the time horizon) are expected to be negligible when discounted to the present"; this implies that a fairly long-time horizon is appropriate. However, the probability that the rule becomes obsolete increases over time. For example, international regulations and chemical manufacturer agreements, or new chemical innovations, could make decaBDE or PIP (3:1) obsolete without any rule. Given this uncertainty, EPA selected a time horizon of 30 years for the analysis. A time horizon of 30 years would allow adequate time for all prohibitions of new products under this rule to come into effect (manufacture of new and replacement parts for aerospace vehicles containing PIP (3:1) is prohibition after 30 years). However, some replacement parts are permitted to contain PIP (3:1) beyond 30 years, in products with a long service life. Since the EPA believes that this rule will not cause an incremental cost in the continued

production of PIP (3:1)-containing replacement parts, EPA contends that a 30-year period of analysis is sufficient to capture the overall costs of the action.

The present discounted value for the annualized value of the stream of costs is estimated using discount rates of 2%, 3%, and 7%. Costs are discounted (for the discount rates  $r = 2\%$ ,  $r = 3\%$ , and  $r = 7\%$ ) to the beginning of the  $n$ -year period (where  $n$  is 30), as follows:

$$\text{Present Discounted Value} = \sum_{t=0}^n \frac{(\text{Undiscounted Value})_t}{(1+r)^t} \quad (1)$$

The present discounted value costs are annualized as follows:

$$(\text{Annualized Costs}) = (\text{PDV}_{n \text{ year cost stream}}) \cdot \frac{r \cdot (1+r)^n}{(1+r)^n - 1} \quad (2)$$

Chapter 4 presents the costs at 3% and 7% discount rates, while Appendix A presents the costs at a 2% discount rate.

#### 4.1.2 Wage Rates

The final rule involves activities that may require efforts by employees in six labor classifications: managerial, professional/technical, production/clerical, attorney, industrial hygienist, and physician's assistant. Costs for each activity are calculated by estimating the number of hours required in each labor category and multiplying those burdens by the wage rate for each labor category. This section presents the estimated wage rate in each labor category.

Loaded wage rates for each labor category are derived by combining data on wages and fringe benefits with estimates of overhead rates following the methodology described in *Handbook on Valuing Changes in Time Use Induced by Regulatory Requirements and Other U.S. EPA Actions* (U.S. Environmental Protection Agency (EPA) 2020b). Wage and fringe benefit data for the manufacturing sector was calculated using the December 2022 quarterly estimates from the Employer Costs for Employee Compensation (ECEC) Supplemental Tables available on the Bureau of Labor Statistics (BLS) website (U.S. Bureau of Labor Statistics (BLS) 2022a). For attorney, industrial hygienist, and physician's assistant labor, the wage rate was taken from the BLS Occupational Employment Statistics (OES) May 2021 Occupational Employment and Wage Estimates (BLS 2022b).

Table 4-1 presents the data used to calculate the loaded wage rates for all four categories of labor, and Appendix A provides more detailed information on the estimation of these wage rates.

**Table 4-1: Loaded Industry Wage Rates (2022\$)**

Labor Category	Base Wages <sup>a</sup>	Fringe Benefits <sup>a</sup> + Overhead Factor <sup>b</sup>	Loaded Wages
<b>Manufacturing</b>			
Managerial	\$54.29	1.75	\$94.74
Professional/Technical	\$46.01	1.81	\$83.14
Production Worker / Clerical	\$23.11	1.74	\$40.13
<b>All Sectors</b>			
Attorney	\$71.17	1.81	\$128.76
Industrial Hygienist	\$37.86	1.81	\$68.41
Physician's Assistant	\$57.43	1.81	\$103.77
Notes:			
<sup>a</sup> Wage rates and fringe benefits are calculated using the December 2022 estimates from (U.S. Bureau of Labor Statistics (BLS) 2023b, and May 2021 estimate from (U.S. Bureau of Labor Statistics (BLS) 2022b). See Appendix B for calculation.			

**Table 4-1: Loaded Industry Wage Rates (2022\$)**

Labor Category	Base Wages <sup>a</sup>	Fringe Benefits <sup>a</sup> + Overhead Factor <sup>b</sup>	Loaded Wages
<sup>b</sup> An overhead rate of 20% of base wages is used here, based on methodology and assumptions in (U.S. Environmental Protection Agency (EPA) 2020b).			

## 4.2 Recordkeeping and Rule Familiarization

### 4.2.1 Recordkeeping

Manufacturers, processors, and distributors of decaBDE and PIP (3:1), or of products or articles containing them, are required to maintain ordinary business records, such as invoices and bills-of-lading, related to compliance with the prohibitions, restrictions, and other provisions of this rule. These records need to be maintained for a period of five years from the date the record is generated. These records must be made available to EPA upon request.

EPA assumes firms keep these records as part of their customary business practices; therefore this requirement is not expected to add any incremental cost. In addition, the requirement that these records be made available to EPA within upon request is assumed to not add any additional cost. See Section 4.4 for recordkeeping costs related to the rule's PPE requirements. Paperwork costs related to PPE are also covered in Section 4.4.4.

### 4.2.2 Rule Familiarization

Rule familiarization is a cost incurred by manufacturers and processors of products containing decaBDE and PIP (3:1) as industry complies with the regulation. EPA assumes that each manufacturer (including importers) and processor of products subject to the rule who will have PPE requirements will spend 3 hours of professional/technical labor in the first year to become familiar with the requirements of the rule and to develop an understanding of what actions are necessary to comply. EPA assumes firms not subject to PPE requirements will spend 1 hour in the first year on rule familiarization. The fully loaded wage rate used to estimate these costs is \$83.14, which was estimated as shown in Table 4-1.

The estimated annualized cost, per firm, for rule familiarization are shown in Table 4-2 for both no PPE and PPE scenarios at 3% and 7% discount rates.

**Table 4-2: Annual Cost for Rule Familiarization, per firm (2022\$)**

Activity	First -Year Burden (hours)	Technical Labor (at \$83.14/hour)	Annualized Cost (3%) (2022\$)	Annualized Cost (7%) (2022\$)
Rule familiarization (no PPE)	1	\$83.14	\$4.04	\$6.20
Rule familiarization (PPE)	3	\$83.14	\$12.11	\$18.60
<b>Notes:</b>				
Values may not sum due to rounding				
Rule familiarization burdens follow recent TSCA rulemakings such as the proposed rules to regulate Methylene Chloride (U.S. Environmental Protection Agency (EPA) 2023e) and Carbon Tetrachloride (U.S. Environmental Protection Agency (EPA) 2023d).				

To estimate the total cost to industry of rule familiarization, it was assumed that each of the affected companies identified in Chapter 3 will incur this cost. In Table 4-3, the second column shows the estimated number of firms impacted per use, while the third and fourth columns represent the product of the number of firms and the annualized rule familiarization costs presented in Table 4-2.

As shown in Table 4-3, the annual cost to industry under the final option is approximately \$212,000 at a 3% discount rate and \$325,000 at a 7% discount rate, spread among the 26,805 affected companies (as noted in Chapter 3, this may be an overestimate of the number of companies as not all companies within a NAICS category may be affected). As shown in Table 4-4, the annual cost to industry under the alternative option is approximately \$193,000 at a 3% discount rate and \$297,000 at a 7% discount rate, for 22,939 companies.

**Table 4-3: Annual Cost of Rule Familiarization to Industry (Final Option) (2022\$)**

Use	Number of Firms Affected <sup>1</sup>	Total Annualized Cost (3%) (2022\$) <sup>2</sup>	Total Annualized Cost (7%) (2022\$) <sup>2</sup>
<b>DecaBDE</b>			
Plastic Shipping Pallets	1	\$12	\$19
Replacement Parts for Aerospace Vehicles (makers)	0	\$0	\$0
Replacement Parts for Motor Vehicles (makers)	0	\$0	\$0
Wire and Cable Insulation	1	\$4	\$6
<b>All DecaBDE Uses</b>	<b>2</b>	<b>\$16</b>	<b>\$25</b>
<b>PIP (3:1)</b>			
Lubricants and Greases (except Aerospace and Turbine) (makers)	5	\$61	\$93
Lubricants & Greases (Aerospace) (makers)	11	\$133	\$205
New and Replacement Parts for Motor Vehicles (consumers)	4,562	\$18,412	\$28,287
New and Replacement Parts for Motor Vehicles (makers)	8,091	\$97,967	\$150,507
New and Replacement Parts for Aerospace Vehicles (consumers)	324	\$1,308	\$2,009
New and Replacement Parts for Aerospace Vehicles (makers)	1,787	\$21,633	\$33,235
Wire Harnesses and Electric circuit Boards (makers)	1,780	\$21,548	\$33,105
Marine Antifouling Coatings	1	\$12	\$19
Articles Used in Manufacturing Equipment, Semiconductor Industry, and HVACR, Power Generating, and Electronic Equipment (makers)	1,165	\$14,102	\$21,665
Articles Used in Manufacturing Equipment, Semiconductor Industry, and HVACR, Power Generating, and Electronic Equipment (consumers)	9,071	\$36,610	\$56,244
Engine Filters for Locomotive and Marine Applications	1	\$12	\$19
Cyanoacrylate Adhesives <sup>1</sup>	0	\$0	\$0
Aviation Hydraulic Fluid (makers)	5	\$61	\$93
<b>All PIP (3:1) Uses</b>	<b>26,803</b>	<b>\$211,859</b>	<b>\$325,480</b>
<b>Total</b>	<b>26,805</b>	<b>\$211,875</b>	<b>\$325,505</b>

**Sources:** <sup>1</sup> See Table 3-29; <sup>2</sup> See Table 4-2

**Note:** Total annualized costs have been adjusted down proportionately for PIP (3:1) so as not to include double counting.

<sup>1</sup> Henkel is not included since they use PIP (3:1) in a closed-loop system in the baseline.

**Table 4-4: Annual Cost of Rule Familiarization to Industry (Alternative Option) (2022\$)**

Use	Number of Firms Affected <sup>1</sup>	Total Annualized Cost (3%) (2022\$) <sup>2</sup>	Total Annualized Cost (7%) (2022\$) <sup>2</sup>
<b>DecaBDE</b>			
Other DecaBDE-containing Plastic	8,894	\$107,684	\$165,436
<b>All DecaBDE Uses</b>	<b>8,894</b>	<b>\$107,684</b>	<b>\$165,436</b>
<b>PIP (3:1)</b>			
Lubricants and Greases (except Aerospace and Turbine) (makers)	5	\$61	\$93
Lubricants & Greases (Aerospace) (makers)	11	\$133	\$205

**Table 4-4: Annual Cost of Rule Familiarization to Industry (Alternative Option) (2022\$)**

Use	Number of Firms Affected <sup>1</sup>	Total Annualized Cost (3%) (2022\$) <sup>2</sup>	Total Annualized Cost (7%) (2022\$) <sup>2</sup>
Articles Used in Manufacturing Equipment, Semiconductor Industry, and HVACR, Power Generating, and Electronic Equipment (makers)	1,462	\$17,695	\$27,185
Articles Used in Manufacturing Equipment, Semiconductor Industry, and HVACR, Power Generating, and Electronic Equipment (consumers)	10,491	\$42,340	\$65,047
Wire Harnesses and Electric circuit Boards (makers)	2,077	\$25,141	\$38,625
<b>All PIP (3:1) Uses</b>	<b>14,045</b>	<b>\$85,370</b>	<b>\$131,155</b>
<b>Total</b>	<b>22,939</b>	<b>\$193,054</b>	<b>\$296,591</b>

**Sources:** <sup>1</sup> See Table 3-29; <sup>2</sup> See Table 4-2.

**Note:** Total annualized costs have been adjusted down proportionately for PIP (3:1) so as not to include double counting.

### 4.3 Prohibition Costs

The final option for PIP (3:1) calls for prohibition against the use of the chemical for certain activities, with various compliance timelines. The requirements (under both the final and primary alternative options) related to prohibition are:

- For lubricants and greases (excluding turbine engine and aerospace uses), the final option prohibits processing after 15 years. Lubricants and greases for turbine engine and aerospace uses will not be prohibited.
- For all lubricants and greases, the alternative option would prohibit processing after 5 years
- For new parts for motor vehicles, the final option prohibits processing after 15 years. Replacement part prohibition would take effect after 30 years.
- For new parts for aerospace vehicles, the final option prohibits processing after 30 years. Replacement part prohibition would take effect at the end of service life.
- For wire harnesses and electric circuit boards, the alternate option prohibits manufacture (including import), and processing after 20 years
  - For articles used in manufacturing equipment, semiconductors, electronic equipment, HVACR and water heating equipment, and power generating equipment, the final option prohibits manufacture (including import) and processing after 10 years. For replacement parts, the prohibitions take effect as follows:
    - Manufacturing and semiconductor equipment: service life of machine
    - Electronic Equipment: 7 years for consumer use, 25 years for industrial and commercial use, and service live for laboratory use
    - HVACR and water heating equipment: 25 years
    - Power generating equipment: 25 years
- For articles used in manufacturing equipment and semiconductors, the alternate option would prohibit manufacture (including import) and processing after 20 years.

For all articles, EPA is also prohibiting the distribution in commerce of PIP (3:1)-containing articles. Prohibitions for distribution in commerce will take effect 2 years after prohibitions of manufacturing (including import) and processing. EPA does not believe that the regulatory options result in costs to prohibition of distribution.

When the use of a chemical is prohibited, EPA expects that firms using affected articles (e.g., makers of automobiles) assess their supply chain in order to ensure that these components do not contain the prohibited chemical. Identifying the chemical in imported articles can be more challenging and is discussed below. Costs are described in Section 4.3.1.

Furthermore, EPA expects the regulated manufacturers or processors to reformulate the affected products. Reformulation costs include activities such as research and development, laboratory testing, and product re-labeling. Costs are described in Section 4.3.2.

Prohibition costs are expected to be one-time costs, likely incurred in the initial year of the rule's applicability.<sup>20</sup> Uses of the chemicals to be prohibited under this rule include those for which there is no current substitute chemical, which is why EPA is providing an extended timeline for the prohibition.

EPA does not believe that the regulatory options result in costs to distributors. Section 4.9.4 discusses unquantified costs and uncertainties related to prohibition.

#### 4.3.1 Supply Chain Analysis

Based on (U.S. Environmental Protection Agency (EPA) 2014d), the following is a list of activities that a company might perform to identify specific chemicals in articles within its supply chain. These costs apply to the consumers of affected articles, not the manufacturer. This was developed based in part on ASTM F2577<sup>21</sup> and on example processes described in industry guidance, such as (AFIRM 2022). This list is intended to capture the general types of activities performed. Whether or not an individual company undertakes each specific listed activity, and the extent to which each is performed, likely depends on a number of factors, such as the size of the company and the complexity of its supply chain. Furthermore, as the prohibition takes effect, users of articles could expect that only imported products would contain PIP (3:1) as it will no longer be used domestically.

- 1) Understand applicable requirements.** The company would read and understand the rule, within the context of the company's products. As noted in ASTM F2577-06, "The first step in any assessment is to determine what is covered by requirements, or the scope of the requirements." Frequency: this is a one-time activity.
- 2) Identify the types of articles that potentially contain the chemicals subject to the rule** (i.e., PIP (3:1)). A list of the kinds of articles that the company uses that have the potential to contain the chemical can be developed based on an understanding of the uses of the subject substance; use categories for PIP (3:1) have been described. ASTM F2577-06 says to "apply a priori knowledge

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<sup>20</sup> Reformulation costs could be spread over multiple years; for the purpose of this analysis, it is assumed that these costs are incurred as soon as possible.

<sup>21</sup> ASTM F2577, *Standard Guide for Assessment of Materials and Products for Declarable Substances*, provides a general description of the process of assessing materials and/or products for the content of declarable (or restricted) substances. It relies on two means for this assessment: both a priori and a posteriori knowledge. Therefore, determinations can be made based on information gleaned through logical deduction and scientific principles (a priori knowledge), as well as on observation, experience and known facts (a posteriori knowledge) including laboratory tests to verify or generate information on the concentration of a chemical substance (AFIRM 2022).

[based upon scientific principles and logical deduction] of the material and its manufacture to assess the probability whether each [regulated] substance may be present.” The level of effort called for here may depend on the complexity of the product being manufactured and the article itself; an airplane, for example, has many components to consider. Frequency: an initial review of the company’s supply chain would be a one-time activity; however, a company may do a similar review on each potential new article purchased to determine whether it likely contains restricted chemical substances. U.S. Environmental Protection Agency (EPA) 2009). The total burden can vary from two hours per year up to two hours per month (24 hours per year), depending on the number of products exported [imported] by the company (U.S. Environmental Protection Agency (EPA) 2009). EPA for this analysis has chosen to use the higher estimate of 24 hours.

**3) Identify all suppliers involved.** Companies may identify the suppliers from whom the articles identified in the previous step are purchased, and as appropriate, make them aware of the rule. Frequency: an initial identification of suppliers will be a one-time activity; however, a company may assess each new supplier.

Burden for this activity was taken from (U.S. Environmental Protection Agency (EPA) 2014d). After the potentially affected articles are identified, the users may identify suppliers of the articles identified in the previous step. This involves examining the company’s existing records, and potentially contacting the suppliers to make them aware of the chemical restrictions and the importer’s preferred data collection method. Burden is assumed to vary depending on the number of suppliers. Burden is estimated based on the cost for supplier notification associated with reporting requirements for the Toxics Release Inventory (TRI). Under TRI reporting requirements, facilities supplying mixtures and products containing listed chemical substances must notify their customers of the contents of their products on an annual basis. This notification can be provided as a letter to the supplier that identifies the chemical and indicates its percentage by weight in the product formulation. While the TRI reporting activity is not exactly analogous to the activity performed by the users of articles in this rule, work would be similar in that the company’s existing and available records would be examined to develop a set of entities. The U.S. EPA’s *Economic Analysis of the Final Rule to Modify Reporting of Persistent Bioaccumulative Toxic Chemicals under EPCRA Section 313* (U.S. Environmental Protection Agency (EPA) 1999) estimates the supplier notification burden to be 7 hours of technical staff time and 17 hours of clerical staff time per facility, regardless of facility characteristics.

**4) Collect data from suppliers.** Companies may obtain verification from suppliers that the regulated chemical substance is or is not found in the article. This may be accomplished through various strategies – for example, agreements with suppliers, declarations through databases or surveys, or by using a third-party certification system. In some cases, companies may be able to leverage various reporting requirements, such as Safety Data Sheets (SDS) or the Restriction of Hazardous Substances Directive (RoHS) in Europe, to identify the presence of DecabDE or PIP (3:1) in a supply chain. Frequency: initial data collection from suppliers will be a one-time activity, and any additional data collection a company undertakes as new products are considered and suppliers change will add to the cost. A company may also make periodic confirmations with suppliers reporting any changes in the article’s content or manufacturing process.

The burden of collecting data from suppliers depends on how frequently a user may collect information from suppliers and which suppliers they would collect information from will vary depending on an importer’s experience complying with other regulations, available resources, and as due to a number of supply chain factors. Supply chains can change frequently. Users may use multiple types of articles or models within a single product line that may change over time.

Importers may also use single or multiple suppliers for certain types of articles. Many of these changes can occur throughout an article supply chain prior to the article reaching the end user. These factors could all be considerations for the user when deciding which articles to review for supplier information and how frequently. EPA (U.S. Environmental Protection Agency (EPA) 2014d) estimates that depending on these factors, data collection can take anywhere from 5 minutes to 8 hours per article. EPA uses the upper end estimate of 8 hours per article and makes the simplifying assumption of one article per company.

Burden for these steps was estimated in (U.S. Environmental Protection Agency (EPA) 2014d) and is provided in Table 4-5. For the purpose of this analysis, EPA conservatively assumes that companies have a complex supply chain.

<b>Table 4-5: Cost to Identify Components in Supply Chain that Contain PIP (3:1) (2022\$)</b>					
Activity	Hours per Company (Technical, at \$83.14 per hour)	Hours per Company (Clerical, at \$40.30 per hour)	Cost per Company	Annualized (3%)	Annualized (7%)
Understand applicable requirements	Included in Section 4.2.2				
Identify components that potentially contain PIP (3:1)	24		\$1,995	\$97	\$149
Identify all suppliers	7	17	\$1,264	\$61	\$94
Collect data from suppliers	8		\$665	\$32	\$50
<b>Total</b>			<b>\$3,925</b>	<b>\$191</b>	<b>\$293</b>

**Source:** Understanding the Costs Associated with Eliminating Exemptions for Articles in SNURs (U.S. Environmental Protection Agency (EPA) 2014d). This analysis assumes a complex supply chain, and that no chemical testing of articles to identify the presence of PIP (3:1) will need to be done.

**Note:** Wage rates are as determined in Table 4-1. Costs annualized over 30 years.

### 4.3.2 Reformulation

EPA is phasing in prohibitions for uses of PIP (3:1) within timeframes that EPA believes would allow industry adequate time to develop reformulated products without the chemical. These phased in timeframes are based on information received by stakeholders in public comments on the 2021 final PIP (3:1) rule and the proposal of this final rule, including:

- Uses of lubricants and greases in non-aircraft machinery and non-turbine equipment may not be subject to these same environmental stresses or safety and performance requirements from industry and government as uses in the aerospace sector. In the EA for the 2021 final PIP (3:1) rule (U.S. Environmental Protection Agency (EPA) 2021b), EPA listed potential alternatives for non-turbine, non-aerospace uses that are currently available on the market. In addition, during the March 2021 notification and comment period, stakeholders indicated that they were working to identify alternatives to and/or eliminate PIP (3:1) from lubricant and grease formulation, while acknowledging for some applications they might not be able to find a replacement. At least one stakeholder requested a 5-year transition period to move away from PIP (3:1) for their applications (National Elevator Industry 2021). Based on this information, EPA proposed a 5-year phase-in prohibition believed to be a practicable amount of time for users to research, formulate, and test alternative products for such non-aerospace, non-turbine uses. During the public comment period for the proposed rule, EPA received feedback from multiple stakeholders that 5 years was not sufficient time (Japan Electronics and Information Technology Industries Association (JEITA) 2023, Japan Auto Parts Industries Association (JAPIA) 2023, Japan

Agricultural Machinery Manufacturers Association 2024, National Marine Manufacturers Association 2024, Association for Advancing Automation (A3) 2024). Based on these comments, EPA has increased the phased in prohibition for uses of lubricants and greases in non-aircraft machinery and non-turbine equipment to 15 years for the final rule.

Stakeholders representing manufacturers of new original equipment and aftermarket components, systems, and materials for use in passenger cars, cars and light trucks indicated that that, under the assumption that an alternative to PIP (3:1) could be found in the next three to four years, the industry could transition out of using PIP (3:1) within a seven to ten year time frame (Motor & Equipment Manufacturers Associates (MEMA) and Auto Innovators 2021 ). EPA acknowledges that the timeframe contains many contingencies which could delay the adoption of PIP (3:1) alternatives. Nevertheless, based on the industry's own description of their experience with transitioning from a different chemical, albeit under different circumstances, and the time frames provided, EPA believes the 15-year phase-in prohibition on processing of PIP (3:1) for new parts and a 30-year phase-in prohibition for replacement parts is practicable.

- EPA believes the reasoning applied to the use of PIP (3:1) in new and replacement parts for motor vehicles also applies to the use of PIP (3:1) for new and replacement parts in aerospace vehicles. EPA acknowledges, however, that the regulatory and safety requirements for the aerospace industry can be more stringent and is therefore introducing a longer time period of 30 years for the prohibition of the manufacturing, processing and distribution in commerce of products for use in new and replacement parts for aerospace vehicles.
- One industry commenter (Boeing 2024) expressed support for 30-year prohibition, noting that the FAA recertification process that is often necessary in implementing any alternative solutions is a multiyear, unpredictable, and lengthy process. This comes after the process of qualifying an alternative, which often takes more than 10 years, in part because it requires the help of supply chain, formulators, and if applicable the DoD, to address all the stringent technical specification requirements.
- PIP (3:1) use in articles used in manufacturing equipment, in the semiconductor industry, and in HVACR, power generating, and electronic equipment was prohibited under the 2021 final rule and the compliance date was extended to October 2024 (40 CFR § 751.401(a)(2)(iii)). This rule extends the time until prohibition takes effect for these specific articles. Specifically, this final rule prohibits the processing and distribution of these PIP (3:1) and PIP (3:1)-containing articles after 10 years. Cost of prohibition was already considered for the 2021 rule<sup>22</sup>, and the effect of this rule's compliance date extension would effectively be a cost savings for these companies. Similarly, the rule extends the compliance date for prohibition of PIP (3:1) in marine anti-fouling coatings, so this rule provides a cost savings for that use as well. Due to the compliance delay, reformulation costs would be incurred in later years than they would be incurred in the baseline and are thus discounted further. The cost savings are the differential between the reformulation costs incurred in the final rule scenario compared to the reformulation costs incurred in the baseline scenario. The cost savings are shown as negative values in the total cost estimates.
- After receiving comment on the proposed rule, EPA is expanding the phase-out of PIP (3:1) in replacement parts (Japan Electronics and Information Technology Industries Association (JEITA)

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<sup>22</sup> In the 2021 Final Rule Economic Analysis, reformulation costs were acknowledged qualitatively and were therefore not included in the numerical total cost estimate.

2023, SEMI 2024, Outdoor Power Equipment Institute 2024, Boeing 2024, Association for Advancing Automation (A3) 2024, Chemical Users Coalition 2024, Nuclear Energy Institute 2024, AMT- The Association For Manufacturing Technology 2024, Air-Conditioning Heating and Refrigeration Institute 2024, Semiconductor Industry Association (SIA) 2024, Consumer Technology Association 2024) in articles across industries for additional years beyond the phase-in for new parts, the length of which vary depending on the type of equipment. EPA believes that it will not be necessary for firms to further reformulate replacement parts during these additional years since adequate time is given to reformulate during the initial phase-out of new parts.

In order to understand the magnitude of cost to reformulate a product without using PIP (3:1), EPA reviewed comments submitted during the public comment period for the PBT rules finalized in January 2021 (docket identification number EPA-HQ-OPPT-2019-0080) and for the additionally requested comments in March 2021 (docket identification number EPA-HQ-OPPT-2021-0202). Any information related to costs (including reformulation and testing costs) were summarized, along with any referenced studies for further review. Potential reformulation costs as described by the commenters ranged from \$1 million to \$100 million per product; however, information related to these cost calculations was limited and/or incomplete, and these values would require additional detail or validation to serve as a useful estimate for reformulation costs and were therefore not used in this analysis.

Alternatively, for this analysis, EPA relies on a review of available studies related to reformulation costs, including a 2006 Cheminfo Services Inc. study for Environment Canada on compliance costs associated with volatile organic compounds (VOC) emissions in automotive aftermarket products. Studies completed as part of the European Chemicals Agency (ECHA) Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH) process were also considered (see Sensitivity Analysis in Chapter 7).

The 2006 study by Cheminfo Services<sup>23</sup> surveyed the capital costs of reformulation for 39 products including brake cleaners, lubricants, degreasers, and metal polishes (Cheminfo Services Inc. 2006). Capital costs included the research to develop new formulations, new equipment, and new packaging. Adjusted from Canadian dollars and for inflation to 2022 dollars, the study estimated a minimum reformulation cost of \$0, a mean of \$26,800, and a maximum of \$93,500 USD. Given the expected complexity of reformulation of products containing PIP (3:1), this analysis uses the maximum cost estimated by Cheminfo. Use of the Cheminfo study is consistent with the approach used in EPA's *Final Rule—Economic Analysis of Regulation of 2 Methylene Chloride, Paint and Coating Remover under 3 TSCA Section 6(a)* (EPA Docket EPA-HQ-OPPT-2016-0231).<sup>24</sup> Section 8.1 examines prohibition costs using a different source for estimating the cost of prohibition in a sensitivity analysis. Specifically, the sensitivity analysis utilizes a study by the ECHA Committee for Socio-Economic Analysis on siloxanes D4/D5.

As noted above, the final regulatory option includes time-limited exclusions from prohibition that result in various lengths of time until a use of PIP (3:1) is prohibited. Having more time to reformulate the product results in lower annualized costs because the cost is assumed to be incurred further into the future. Table 4-6 shows the annualized costs for the time-limited exclusions from prohibition considered under this rulemaking, based on the average reformulation cost as estimated by Cheminfo. Not including

<sup>23</sup> Reference is available at: <https://www.regulations.gov/document/EPA-HQ-OPPT-2016-0231-0095>

<sup>24</sup> The economic analysis for the Methylene Chloride rule used the mean cost value given the similarity of the study chemical. In this analysis, EPA conservatively uses the high-end cost estimation.

cost savings, costs ranged from \$1,925 and \$980 (prohibition at 30 years) to \$4,537 and \$6,970 (prohibition before first year) annualized at 3 percent and 7 percent discount rates, respectively. Annualization is calculated over a time horizon of 30 years for all scenarios, as described in Section 4.1.1.

Uses that were prohibited under the 2021 final rule or uses that would be prohibited starting on October 30<sup>th</sup>, 2024, absent this rule, will realize cost savings relative to the baseline. The cost savings are estimated as the differential between incurring the costs beginning on October 30<sup>th</sup>, 2024 (without the rule) and incurring the same costs in later years when the prohibition takes place under the rule. For instance, the annualized cost savings for articles in the manufacturing equipment and the semi-conductor industry would be \$3,477 - \$4,537 = -\$1,060.

Based on comment received on the proposed rule, EPA learned of additional industries that would be impacted by the rule. These industries include electronic equipment, HVACR equipment, and power generating equipment. As a result, new NAICS codes were added to Table 4-7 as “Articles Used in Manufacturing Equipment, Semiconductor Industry, and HVACR, Power Generating, and Electronic Equipment (consumers).” The addition of new industries to this analysis results in additional cost savings relative to the economic analysis for the proposed rule, as these uses were prohibited in the 2021 rule.

<b>Table 4-6: Annualized Reformulation Costs (over 30 years)</b>			
Prohibition Timeframe	Uses	Annualized at 3%	Annualized at 7%
Prohibition before 1st year	• None	\$4,537	\$6,970
Prohibition at 5 years	• None	\$4,031	\$5,317
Prohibition at 10 years	• None	\$3,477	\$3,791
Prohibition at 15 years	• New and Replacement Parts for Motor Vehicles (makers) • Lubricants and Greases (except Aerospace and Turbine) (makers)	\$2,999	\$2,703
Prohibition at 20 years	• None	\$2,587	\$1,927
Prohibition at 30 years	• New and Replacement Parts for Aerospace Vehicles (makers) • Lubricants and Greases (except Aerospace and Turbine) (makers) • Lubricants & Greases (Aerospace) (makers)	\$1,925	\$980
Cost savings at 5 years	• Marine Antifouling Coatings	-\$506	-\$1,653
Cost savings at 10 years	• Articles Used in Manufacturing Equipment, Semiconductor Industry, and HVACR, Power Generating, and Electronic Equipment (makers and consumers)	-\$1,060	-\$3,179
Cost savings at 20 years	• Wire Harnesses and Electric Circuit Boards (makers) • Articles Used in Manufacturing Equipment, Semiconductor Industry, and HVACR, Power Generating, and Electronic Equipment (makers)	-\$1,949	-\$5,042
<b>Note:</b> Costs annualized over 30 years.			
<b>Source:</b> (Cheminfo Services Inc. 2006)			

### 4.3.3 Total Prohibition Costs

As described in Section 4.3, prohibition costs were estimated for companies that manufacture an article containing PIP (3:1) (makers, reformulation costs as estimated in 4.3.2) and for those who use those

articles (consumers, supply chain analysis as estimated in 4.3.1). Each of these types of costs depend on the number of products/articles affected.

For lubricants and greases, EPA identified 18 affected non-aerospace/turbine formulated products (see Table 3-15). These products are currently available for sale in the United States and EPA expects that the manufacturers will incur costs to reformulate and stop selling them within the prohibition timeframe. They are manufactured in the United States and are not articles. Therefore, EPA does not expect consumers of these products to research supply chains.

For new and replacement parts for motor vehicles and aerospace vehicles, the number of affected parts is unknown<sup>25</sup>. EPA uses the number of firms in each affected NAICS code (see Table 3-18 and Table 3-20) as a proxy for the number of parts. EPA understands that it is likely for companies who manufacture affected parts to make more than one, however it is unlikely that every company in the NAICS does make parts using PIP (3:1) so an average of 1 part per company may be reasonable. Articles<sup>26</sup> included in these parts may be imported, thus the consumers of the parts need to assess their supply chain to ensure that such parts are not used after the prohibition date.

Negative values indicate cost savings. Cost saving result from additional compliance delays beyond those included in the 2021 PBT rule. See the reformulation section (4.3.2) for further explanation.

Table 4-7 provides the estimated prohibition costs for the final regulatory option. Table 4-8 provides the estimated prohibition cost associated with the primary alternative option.

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<sup>25</sup> As described in Section 3.3.2, the regulated community provided, in comments, lists of potentially affected parts but was not able to determine an exact number, as supply chain analysis is still ongoing. The Aerospace Industries Association (AIA), for example, noted that aerospace products consist of thousands of parts, so EPA believes that the order of magnitude estimated here is accurate.

<sup>26</sup> Article means a manufactured item (1) which is formed to a specific shape or design during manufacture, (2) which has end use function(s) dependent in whole or in part upon its shape or design during end use, and (3) which has either no change of chemical composition during its end use or only those changes of composition which have no commercial purpose separate from that of the article, and that result from a chemical reaction that occurs upon end use of other chemical substances, mixtures, or articles; except that fluids and particles are not considered articles regardless of shape or design." See [https://www.epa.gov/sites/default/files/documents/articlesfactsheetforcdr\\_reporting\\_080312.pdf](https://www.epa.gov/sites/default/files/documents/articlesfactsheetforcdr_reporting_080312.pdf)

**Table 4-7: Prohibition Costs by Chemical and Use (Final Option) (2022\$)**

Chemical and Use	Time until Prohibition (years)	Number of Products	Annualized 3%		Annualized 7%	
			Cost per Product	Total Cost	Cost per Product	Total Cost
<b>PIP (3:1)</b>						
Lubricants and Greases (except Aerospace and Turbine) (makers)	15	18	\$2,999	\$53,982	\$2,703	\$48,654
New and Replacement Parts for Motor Vehicles (consumers)	15	4,562	\$191	\$871,374	\$293	\$1,336,715
New and Replacement Parts for Motor Vehicles (makers)	15	8,091	\$2,999	\$24,266,159	\$2,703	\$21,871,099
New and Replacement Parts for Aerospace Vehicles (consumers)	30	324	\$191	\$61,884	\$293	\$94,932
New and Replacement Parts for Aerospace Vehicles (makers)	30	1,787	\$1,925	\$3,439,494	\$980	\$1,751,015
Marine Antifouling Coatings <sup>1</sup>	5	1	-\$506	-\$506	-\$1,653	-\$1,653
Articles Used in Manufacturing Equipment, Semiconductor Industry, and HVACR, Power Generating, and Electronic Equipment (makers) <sup>1</sup>	10	1,165	-\$1,060	-\$1,234,256	-\$3,179	-\$3,702,287
Articles Used in Manufacturing Equipment, Semiconductor Industry, and HVACR, Power Generating, and Electronic Equipment (consumers) <sup>1</sup>	10	9,071	-\$45	-\$403,675	-\$133	-\$1,210,867
<b>All PIP (3:1)</b>				<b>\$27,054,456</b>		<b>\$20,187,608</b>
<b>Note:</b> Costs annualized over 30 years.						
<sup>1</sup> Negative values indicate cost savings. Cost savings result from additional compliance delays beyond those included in the 2021 PBT rule. See the reformulation section (4.3.2) for further explanation.						
<b>Source:</b> See Table 4-5 (consumers) and Table 4-6 (makers)						

**Table 4-8: Prohibition Costs by Chemical and Use (Alternative Option) (2022\$)**

Chemical and Use	Time until Prohibition (years)	Number of Products	Annualized 3%		Annualized 7%	
			Cost per Product	Total Cost	Cost per Product	Total Cost
<b>PIP (3:1)</b>						
Lubricants and Greases (except Aerospace and Turbine) (makers)	5	18	\$4,031	\$72,558	\$5,317	\$95,706
Lubricants & Greases (Aerospace) (makers)	5	10	\$4,031	\$40,310	\$5,317	\$53,170
Wire Harnesses and Electric Circuit Boards (makers) <sup>1</sup>	20	2,077	-\$1,949	-\$4,048,015	-\$5,042	-\$10,470,681
Articles Used in Manufacturing Equipment, Semiconductor Industry, and HVACR, Power Generating, and Electronic Equipment (makers) <sup>1</sup>	20	1,462	-\$1,949	-\$2,849,108	-\$5,042	-\$7,369,564
Articles Used in Manufacturing Equipment, Semiconductor Industry, and HVACR, Power Generating, and Electronic Equipment (consumers) <sup>1</sup>	20	10,491	-\$82	-\$858,861	-\$212	-\$2,221,549
<b>All PIP (3:1)</b>				<b>-\$7,643,116</b>		<b>-\$19,912,918</b>
Note: Costs annualized over 30 years.						
1 Negative values indicate cost savings. Cost savings result from additional compliance delays beyond those included in the 2021 PBT rule. See the reformulation section (4.3.2) for further explanation.						
Source: See Table 4-5 (consumers) and Table 4-6 (makers)						

#### 4.4 Worker Protection Costs

Worker protection requirements related to uses of decaBDE that call for use of personal protective equipment (PPE) in the rule are as follows:

- For plastic shipping pallets, the rule requires inhalation and dermal PPE (i.e., APF 10 and chemical-resistant gloves) during the recycling process of pallets known to contain decaBDE
- For the manufacture and processing of decaBDE for use in aerospace replacement parts and the manufacture of such parts, but not the processing of parts to which decaBDE has been added, the rule requires inhalation and dermal PPE (i.e., N95, and chemical-resistant gloves)
- For the manufacture and processing of decaBDE for use in motor vehicle replacement parts and the manufacture of such parts, but not the processing of parts to which decaBDE has been added, the rule requires inhalation and dermal PPE (i.e., N95 and chemical-resistant gloves)
- For recycling of all other decaBDE-containing plastic products, the alternative option would require inhalation and dermal PPE (i.e., APF 10 and chemical-resistant gloves) during the recycling process

Requirements related to uses of PIP (3:1) that call for use of PPE are as follows for the final and alternative options:

- For lubricants and greases, the rule requires use of gloves, as well as a respirator at least as protective as a NIOSH-approved APF 10 air-purifying half mask respirator.

- For new and replacement parts for motor vehicles, the rule requires a respirator at least as protective as a N95 mask and dermal PPE (gloves that are chemically resistant to PIP (3:1) with activity-specific training where dermal contact with PIP (3:1) is possible) during manufacturing and processing, excluding processing of parts to which PIP (3:1) has been added.
- For new and replacement parts for aerospace vehicles, the rule requires a respirator at least as protective as an N95 masks and dermal PPE (gloves that are chemically resistant to PIP (3:1) with activity-specific training where dermal contact with PIP (3:1) is possible) during manufacturing and processing, excluding processing of parts to which PIP (3:1) has been added.
- For wire harnessing and electric circuit boards, the rule requires inhalation and dermal PPE (a respirator at least as protective as a APF 10 air-purifying half mask respirator and gloves that are chemically resistant to PIP (3:1) with activity-specific training where dermal contact with PIP (3:1) is possible).
- For marine antifouling coatings, the rule requires inhalation and dermal PPE (a respirator at least as protective as a NIOSH-approved APF 10 air-purifying half mask respirator and gloves that are chemically resistant to PIP (3:1) with activity-specific training where dermal contact with PIP (3:1) is possible).
- For articles used in manufacturing equipment and the semiconductor industry, as well as HVACR, power generating, and electronic equipment, the rule requires inhalation and dermal PPE (a respirator at least as protective as a NIOSH-approved APF 10 air-purifying half mask respirator and gloves that are chemically resistant to PIP (3:1) with activity-specific training where dermal contact with PIP (3:1) is possible), excluding processing of parts to which PIP (3:1) has been added.
- For specialized engine filters, the rule requires gloves that are chemically resistant to PIP (3:1) with activity-specific training where dermal contact with PIP (3:1) is possible and half or full respirator.
- For cyanoacrylate adhesives, the rule requires a respirator at least as protective as an APF 50 respirators and gloves that are chemically resistant to PIP (3:1) with activity-specific training where dermal contact with PIP (3:1) is possible. APF 50 respirators are already being used in the baseline under this COU.
- For aviation hydraulic fluids, the rule requires a respirator at least as protective as a NIOSH-approved APF 10 air-purifying half mask respirator and gloves that are chemically resistant to PIP (3:1) with activity-specific training where dermal contact with PIP (3:1) is possible, during manufacturing and processing.

These requirements are summarized in Table 4-9. Costs associated with each of these types of protective equipment will depend on the phased-in prohibition time, as applicable (that is, PPE will only need to be used for the number of years until the use is prohibited – see Section 4.3 for description of prohibition timeframes). PPE costs are assessed in the following sections.

**Table 4-9: Summary of Worker Protection Requirements (Final Option)**

Chemical and Use	Inhalation Protection	Dermal Protection	Years of Use <sup>1</sup>
<b>DecaBDE</b>			
Plastic Shipping Pallets	N95	Chemical-resistant gloves	30
Replacement Parts for Aerospace Vehicles (makers)	N95	Chemical-resistant gloves	30
Replacement Parts for Motor Vehicles (makers)	N95	Chemical-resistant gloves	30
<b>PIP (3:1)</b>			

**Table 4-9: Summary of Worker Protection Requirements (Final Option)**

Chemical and Use	Inhalation Protection	Dermal Protection	Years of Use <sup>1</sup>
Lubricants and Greases (except Aerospace and Turbine) (makers)	Air-purifying half mask	Chemical-resistant gloves	15
Lubricants & Greases (Aerospace) (makers)	Air-purifying half mask	Chemical-resistant gloves	30
New and Replacement Parts for Motor Vehicles (makers)	N95	Chemical-resistant gloves	15
New and Replacement Parts for Aerospace Vehicles (makers)	N95	Chemical-resistant gloves	30
Wire Harnesses and Electric Circuit Boards (makers)	Air-purifying half mask	Chemical-resistant gloves	30
Marine Antifouling Coatings	Air-purifying half mask	Chemical-resistant gloves	5
Articles Used in Manufacturing Equipment, Semiconductor Industry, and HVACR, Power Generating, and Electronic Equipment (makers)	Air-purifying half mask	Chemical-resistant gloves	10
Engine Filters for Locomotive and Marine Applications	Air-purifying half mask	Chemical-resistant gloves	30
Cyanoacrylate Adhesives	APF 50	Chemical-resistant gloves	30
Aviation Hydraulic Fluid (makers)	Air-purifying half mask	Chemical-resistant gloves	30

<sup>1</sup> Worker protection will be required for additional years for use in replacement parts. Specifically, it will be required for 30 years in motor vehicles and aerospace vehicles; 7 years in electronic equipment for personal use; 25 years for in electronic equipment for commercial use, HVACR and water heating equipment, and power generating equipment; and service life in manufacturing equipment, including semiconductor manufacturing, and laboratory equipment.

**Table 4-10: Summary of Worker Protection Requirements (Primary Alternative Option)**

Chemical and Use	Inhalation Protection	Dermal Protection	Years of Use
<b>DecaBDE</b>			
Other DecaBDE-containing Plastic	Air-purifying half mask	Chemical-resistant gloves	30
<b>PIP (3:1)</b>			
Lubricants & Greases (Aerospace) (makers)	Air-purifying half mask	Chemical-resistant gloves	30
Lubricants and Greases (except Aerospace and Turbine) (makers)	Air-purifying half mask	Chemical-resistant gloves	5
Wire Harnesses and Electric Circuit Boards (makers)	Air-purifying half mask	Chemical-resistant gloves	20
Articles Used in Manufacturing Equipment, Semiconductor Industry, and HVACR, Power Generating, and Electronic Equipment (makers)	Air-purifying half mask	Chemical-resistant gloves	20

#### 4.4.1 Number of Affected Workers and Compliance Rates

##### Affected Workers

PPE costs depend on the number of workers required to use such protection. Since EPA does not have company-level data for each company affected, the Agency used assumptions about the categories of workers employed within each affected NAICS code. EPA examined U.S. BLS' Occupational Employment and Wage Statistics (OEWS), Research Estimates by State and Industry data (BLS 2022b). For the NAICS code at the highest level available (e.g., 4-digit level 3132), EPA reviewed the Standard Occupational Classification titles (SOC codes) to identify those occupations where workers are potentially using or handling the regulated chemical (see Appendix C for lists of codes and use/handling status). Whether or not a worker within the SOC code was considered likely to handle or use the chemical was based on the descriptions/examples of the occupation categories found on BLS' 2018 *Standard*

*Occupational Classification System* webpage (BLS 2020) and EPA's understanding of the relevant industries. With the OEWS employment numbers for each SOC code, EPA calculated the percent of employees likely to handle or use the chemical for each 3- or 4-digit NAICS (see Appendix C, Table C-1 through Table C-16). EPA then applied that percentage to the average number of employees per firm (derived from SUSB data) in each relevant 6-digit NAICS code. These calculations are shown in Table F-1.

### **Baseline Compliance**

EPA expects that some industries already provide PPE for their workers, and thus, the required respiratory and hand protection does not result in an incremental cost. EPA assumes that for Cyanoacrylate Adhesives, APF 50 respirators are already being used in the baseline.

Because the OSHA requirements (29 CFR 1910) generally do not require specific types of protective equipment, EPA looked for industry guidelines or other publications to determine the type of worker protection commonly used. For sectors for which EPA was able to determine that an industry standard exists, EPA compared the standard to the requirement to determine whether it was more or less stringent. If the protection assumed to be currently used was less stringent, EPA would determine the incremental cost for the required equipment; however, in no cases was the standard determined to be less stringent. Table 4-11 summarizes whether standard levels of worker protection were found for each industry. See Appendix D for the list of baseline PPE equipment identified and sources.

**Table 4-11: Summary of Whether Standard Industry PPE was Identified for Regulated NAICS**

NAICS Code	NAICS Description	Inhalation (Respirators)	Dermal (Gloves)
3261	Plastics Product Manufacturing	yes	yes
324110	Petroleum Refineries	no	yes
324191	Petroleum Lubricating Oil and Grease Manufacturing	no	yes
325180	Other Basic Inorganic Chemical Manufacturing	yes	yes
325199	All Other Basic Organic Chemical Manufacturing	yes	yes
325211	Plastics Material and Resin Manufacturing	no	no
325510	Paint and Coating Manufacturing	yes	yes
325520	Adhesive Manufacturing	no	no
325991	Custom Compounding of Purchased Resins	no	no
326199	All Other Plastics Product Manufacturing	no	no
333242	Semiconductor Machinery Manufacturing	yes	yes
333415	Air-Conditioning and Warm Air Heating Equipment and Commercial and Industrial Refrigeration Equipment Manufacturing	no	yes
334412	Bare Printed Circuit Board Manufacturing	yes	yes
334413	Semiconductor and Related Device Manufacturing	yes	yes
334418	Printed Circuit Assembly (Electronic Assembly) Manufacturing	yes	yes
335931	Current-Carrying Wiring Device Manufacturing	no	yes
336211	Motor Vehicle Body Manufacturing	no	yes
336310	Motor Vehicle Gasoline Engine and Engine Parts Manufacturing	no	yes
336320	Motor Vehicle Electrical and Electronic Equipment Manufacturing	no	yes
336390	Other Motor Vehicle Parts Manufacturing	no	yes
336412	Aircraft Engine and Engine Parts Manufacturing	yes	yes
336413	Other Aircraft Part and Auxiliary Equipment Manufacturing	yes	yes
336415	Guided Missile and Space Vehicle Propulsion Unit and Propulsion Unit Parts Manufacturing	yes	yes
336419	Other Guided Missile and Space Vehicle Parts and Auxiliary Equipment Manufacturing	yes	yes
336991	Motorcycle, Bicycle and Parts Manufacturing	no	yes
336999	All Other Transportation Equipment Manufacturing	no	yes
423120	Motor Vehicle Supplies and New Parts Merchant Wholesalers	no	yes
423840	Industrial Supplies Merchant Wholesalers	no	yes
424690	Other Chemical and Allied Products Merchant Wholesalers	no	yes
488190	Other Support Activities for Air Transportation	yes	yes
562920	Materials Recovery Facilities	yes	yes

**Source:** See Appendix D

As a proxy for how likely the companies within a NAICS code are to follow the PPE standard (when a standard was found), EPA estimated the compliance rate for those sectors where current worker protection use was identified. To estimate the compliance rate, data from OSHA inspections during October 2021 to September 2022 (Occupational Safety and Health Administration (OSHA) 2023) for each NAICS code were used. For example, for NAICS 325180, there was one violation involving respiratory protection out of six inspections performed during the time period, for a rate of 16.7% noncompliance. These calculations are shown in Table 4-12. EPA assumes that noncompliant facilities will incur worker protection costs to come into compliance with the final rule. When no inspections were performed, EPA conservatively assumes 100% noncompliance.

Appendix Table F-1 and Appendix Table F-2 show how the total number of workers who need respiratory and dermal PPE were calculated for the Primary and Alternative Options, respectively.

**Table 4-12: Noncompliance Rates based on OSHA Inspections, October 2021 to September 2022**

NAICS Code	Total Inspections Performed	Inspections with Respiratory Protection Citations	Percent Noncompliant - Respiratory	Inspections with Hand Protection Citations	Percent Noncompliant - Dermal
3261	229	12	5.24%	7	3.06%
324110	9	0	0.00%	1	11.11%
324191	2	0	0.00%	0	0.00%
325180	6	1	16.67%	0	0.00%
325199	6	1	16.67%	0	0.00%
325211	33	4	12.12%	1	3.03%
325510	29	5	17.24%	0	0.00%
325520	12	3	25.00%	0	0.00%
325991	8	4	50.00%	0	0.00%
325998	19	5	26.32%	0	0.00%
333242	1	0	0.00%	0	0.00%
333415	11	2	18.18%	1	9.09%
334412	0	0	100.00%	0	100.00%
334413	2	1	50.00%	0	0.00%
334418	3	0	0.00%	0	0.00%
335931	0	0	100.00%	0	100.00%
336211	12	1	8.33%	0	0.00%
336310	4	1	25.00%	0	0.00%
336320	3	0	0.00%	0	0.00%
336390	30	1	3.33%	0	0.00%
336412	4	1	25.00%	0	0.00%
336413	11	0	0.00%	0	0.00%
336415	0	0	100.00%	0	100.00%
336419	0	0	100.00%	0	100.00%
336991	0	0	100.00%	0	100.00%
336999	3	0	0.00%	0	0.00%
423120	13	1	7.69%	0	0.00%
423840	13	1	7.69%	0	0.00%
424690	13	3	23.08%	1	7.69%
532490	7	0	0.00%	0	0.00%
562920	16	1	6.25%	1	6.25%

**Source:** (Occupational Safety and Health Administration (OSHA) 2023)

#### 4.4.2 Inhalation Protection

Respirators are grouped into different classes defined by the air supply system, operating mode, and the type of facepiece. Firms may provide any respirator that meets or exceeds the requirements stipulated by the rule, however this analysis assumes the following respirator types will be used:

- **N95 Mask.** NIOSH-approved APF 10, air-purifying filtering facepiece/dust mask respirator (commonly referred to as an N95 Mask).

- **APR Half Mask (APF 10).** A NIOSH-approved Air Purifying Respirator (APR) with an air-purifying filter, cartridge, or canister that removes specific air contaminants by passing ambient air through the air-purifying element.

The APF denotes the level of respiratory protection that a given respirator is expected to provide employees. An owner or operator may select any respirator that has an APF equal to or greater than the applicable requirement.

APF 50 respirators are required for the cyanoacrylate adhesives COU. However, APF 50 respirators are already being used in the baseline under this COU. Therefore, unit costs of APF 50 COUs are not presented.

EPA is requiring implementation of a respiratory protection program in alignment with 29 CFR 1910.134, which requires each owner or operator select respiratory protection in accordance with the guidelines for proper respirator use, maintenance, fit-testing, medical evaluation, and training.

Costs associated with inhalation PPE include those for medical evaluation, fit testing, training, and cleaning, as well as for the equipment itself. Each of these costs are detailed in the following sections.

#### **Medical Evaluation Costs**

All employees must receive a medical evaluation before they are required to wear a respirator, (including N95 masks, see (Occupational Safety and Health Administration (OSHA) 2010b). The owner or operator identifies a physician or other licensed health care professional to perform an initial medical evaluation using a medical questionnaire or a medical examination that gathers the same information as the questionnaire. Many respirator distributors are now offering medical questionnaires online. For example, 3M offers the services for \$29 per employee and estimates it will take an employee about 15 minutes to complete (3M 2022). The cost to the owner or operator for this component of the medical evaluation includes the cost of the medical questionnaire service (\$29), plus the loaded wage of an employee for 15 minutes to complete the questionnaire.

Any employee failing the initial medical evaluation must undergo a follow-up examination. It is estimated that 23 percent of employees fail the initial medical evaluation (Occupational Safety and Health Administration (OSHA) 2010b). The total cost of the follow-up medical examination incorporates the cost of the employee's time (time spent traveling, waiting, and being examined) and the cost of the examination. The cost of the employee's time is estimated by multiplying their loaded wage rate by travel time, wait time, and estimated duration of the follow-up medical examination. The cost of the follow-up medical examination is equal to \$210, estimated as the cost presented in OSHA (Occupational Safety and Health Administration (OSHA) 2010b) and inflating the value from 1994 to 2022 dollars using the CPI for medical care services (U.S. Bureau of Labor Statistics (BLS) 2023a).

Table 4-13 presents the estimated per-employee medical evaluation costs. The cost per employee for the medical exam (\$48) was estimated by inflating the cost of a partial limited medical examination (\$75) and multiplying by the 23 percent of employees that fail the initial medical evaluation (Occupational Safety and Health Administration (OSHA) 2010b).

**Table 4-13: Medical Evaluation Costs per Employee (2022\$)**

Cost Input	Cost Per Hour	Number Of Hours Per Employee	Cost Per Employee
Online Medical History Questionnaire Services	-	-	\$29
Cost of Medical Exam <sup>1</sup>	-	-	\$48
Employee Time for Questionnaire	\$40.13	0.25	\$10
Employee Time for Exam <sup>2</sup>	\$40.13	0.46	\$18
<b>Total Medical Evaluation Costs Per Employee</b>			<b>\$105</b>
1 The cost per employee is estimated by inflating the cost of a partial limited medical examination (\$75) and multiplying by the 23 percent of employees that fail the initial medical evaluation (Occupational Safety and Health Administration (OSHA) 2010b).			
2 23 percent of employees that fail the initial medical evaluation and incur a 2-hour labor burden, $23\% \times 2 = 0.46$ hours on average per employee (Occupational Safety and Health Administration (OSHA) 2010b).			

### Fit Testing

Before an employee can wear a negative pressure tight-fitting mask/facepiece respirator, they must be fit tested with the same make, model, style, and size of respirator that would be used. The owner or operator must ensure that employees pass an appropriate qualitative fit test or quantitative fit test. Quantitative fit tests are needed for PAPR, SAR, and SCBA respirators. Quantitative fit test costs are not presented since there are estimated to be no incremental adaptations of these respirator types due to the rule.

Qualitative fit tests may only be used to fit test negative pressure APRs<sup>27</sup> that must achieve a fit factor of 100 or less (29 CFR 1910.134(f)(6)).<sup>28</sup> They involve a chemical test kit that uses an employee's sense of smell, taste, or reaction to an irritant to detect leakage into the mask/facepiece. It is assumed that a manager performs the qualitative fit test, in groups of four employees, and that the test takes an hour to complete per employee and 15 minutes (0.25 an hour) of a manager's time for each employee fitted (Eastern Research Group (ERG) 2003).

Table 4-14 presents the qualitative per-employee fit testing costs. These costs are annual occurrences, as required by 29 CFR 1910.134(f)(2).

**Table 4-14: Annual Qualitative Respirator Fit Testing Costs per Employee (2022\$)**

Cost Input	Cost Per Hour	Number Of Hours Per Employee	Cost Per Employee
Cost of Manager <sup>1</sup>	\$94.74	0.25	\$23.69
Cost of Employee's Time	\$40.13	1	\$40.13
Fit-test Materials <sup>1</sup>			\$0.83
<b>Cost of Qualitative Fit-Test per Employee</b>			<b>\$64.64</b>
1 Cost estimate is an average of four online retailers.			

### Training

After an employee is properly fitted for a respirator, they will receive training to ensure proper use of the equipment. Duration of training varies with the complexity of the respirator. ERG (2003) estimates that APR systems require two hours of training per year. The number of hours per employee for a manager to conduct training is 15 minutes per 1 hour of worker time because training is assumed to be conducted in groups of four (Eastern Research Group (ERG) 2003).

<sup>27</sup> N95 masks are considered to be negative pressure APRs and fit testing is required (Occupational Safety and Health Administration (OSHA) 2010a).

<sup>28</sup> Fit factor is a quantitative estimate of the fit of the respirator, and typically estimates the ratio of the concentration of a substance outside of the respirator to its concentration inside the respirator.

Table 4-15 presents the estimated hourly employee training costs for APR systems.

<b>Table 4-15: Annual APR Training Costs per Employee (2022\$)</b>			
<b>Employee Type</b>	<b>Price/Hour</b>	<b>Number of Hours Per Employee</b>	<b>Cost/Employee</b>
Worker	\$40.13	2	\$80.26
Manager <sup>1</sup>	\$94.74	0.5	\$47.37
<b>Total Cost of Training per Employee</b>			<b>\$127.63</b>

<sup>1</sup>The number of hours per employee for a manager to conduct training is 15 minutes per 1 hour of Worker time because training is assumed to be conducted in groups of four (Eastern Research Group (ERG) 2003).

### Respirator Cleaning

It is estimated that each worker will need clean their (non-disposable) respirator every other shift, or 125 times per year, requiring 5 minutes of labor per cleaning (Occupational Safety and Health Administration (OSHA) 2016a). Thus, the estimated annual labor burden for cleaning is 10.42 hours per worker. The estimated costs by industry sector are presented in Table 4-16.

<b>Table 4-16: Annual Respirator Cleaning Costs (2022\$)</b>			
<b>Employee Type</b>	<b>Price/Hour</b>	<b>Number of Hours Per Employee</b>	<b>Cost/Employee</b>
Worker	\$40.13	10.42	\$418.15

### Respirator Equipment

Estimated unit costs for respirator equipment considered in this analysis were developed by averaging the prices gathered from internet research of popular PPE distributors in 2022, as shown in Appendix E, Table E-1.

Useful life is equal to the number of years until a respirator or respirator component needs to be replaced. The annual replacement rate of a respirator or respirator component, or the annual reoccurrence of other PPE program elements, is therefore equal to 1 divided by the useful life. EPA estimated the useful lives of respirators, respirator components, training, and fit testing, as shown in Appendix E, Table E-3. As described in Appendix E, the elastomeric half masks are replaced every two years and the cartridge filters are replaced at a rate of 100 per year. N95 masks are replaced daily.

Table 4-17 presents unit costs estimates for respirators and respirator system components. Useful lives define the schedule used to discount each cost component before the estimates are annualized over 30 years. Total annual inhalation protection costs are the sum of each applicable unit cost divided by its useful life.

<b>Table 4-17: Annualized PPE Equipment Costs per Worker, by Respirator System</b>				
<b>Respirator System</b>	<b>Component</b>	<b>Unit Cost</b>	<b>Useful Life</b>	<b>Annual Cost</b>
Elastomeric	Half Mask, (APR)	\$27.97	2	\$14
	Cartridge Filters (APR)	\$20.50	0.01	\$2,050
			<b>Total</b>	<b>\$2,065</b>
N95	Half Mask (N95 Mask)	\$1.97	0.004	\$513
			<b>Total</b>	<b>\$513</b>

**Source:** See Appendix E  
**Note:** Useful life based on 2,080 hours per year

### Total Annualized Inhalation Protection Costs

Annual cost components, as estimated in the previous sections, are summarized and totaled in Table 4-18.

**Table 4-18: Total Annual Inhalation Protection Costs, per worker (2022\$)**

Respirator System	Annual Equipment Costs	Annual Medical Evaluation Costs	Annual Fit Test Costs	Annual Training Costs	Annual Cleaning Costs	Total Annual Costs
Elastomeric	\$2,064	\$105	\$65	\$128	\$418	\$2,780
N95	\$513	\$105	\$65	\$128	\$0	\$811

Annualized inhalation protection costs will depend on the number of years during which respirator use takes place. While the analysis timeframe is 30 years (annualization is over 30 years), requirements vary in the number of years until an activity is prohibited. For example, for PIP (3:1), processing and distribution for use in new parts for motor vehicles are prohibited after 15 years, and during that time inhalation and dermal PPE is required; there is no prohibition for PIP (3:1) in aviation hydraulic fluid, so EPA expects PPE to be used for the entire 30-year analysis period. Inhalation protection costs from Table 4-18 were annualized at both 3% and 7% discount rates over 30 years for the numbers of years until prohibition that the final and alternative options cover. These costs are provided in Table 4-19.

**Table 4-19: Annualized Inhalation Protection Costs for Various Years of Use (2022\$)**

Respirator Type	Years of Use	Annualized Cost, 3% Discount Rate	Annualized Cost, 7% Discount Rate
Elastomeric	5	\$637	\$910
Elastomeric	10	\$1,186	\$1,558
Elastomeric	20	\$2,068	\$2,350
Elastomeric	30	\$2,780	\$2,780
N95	15	\$484	\$589
N95	30	\$811	\$811

Appendix F, Table F-3 and Table F-4, sums the costs shown in Table 4-19 for each industry sector, considering the percent of employees who may be affected and baseline compliance rate (affected workers and compliance rates were discussed in Section 4.4.1). Table 4-20 and Table 4-21 show the respiratory protection costs from Table E-1 totaled for each regulatory option (final and primary alternative options, respectively).

**Table 4-20: Total Annualized Respiratory Protection Costs, by Chemical and Use (Final Option) (2022\$)**

Chemical and Use	Number of Workers who need PPE	Annualized Cost, 3% Discount Rate	Annualized Cost, 7% Discount Rate
<b>DecaBDE</b>			
Plastic Shipping Pallets	0	\$0	\$0
Replacement Parts for Aerospace Vehicles (makers)	0	\$0	\$0
Replacement Parts for Motor Vehicles (makers)	0	\$0	\$0
<b>PIP (3:1)</b>			
Lubricants & Greases (except Aerospace and Turbine) (makers)	51	\$90,277	\$107,300
Lubricants and Greases (Aerospace) (makers)	371	\$1,029,967	\$1,029,967
New and Replacement Parts for Motor Vehicles (makers)	326,450	\$175,312,859	\$205,998,051
New and Replacement Parts for Aerospace Vehicles (makers)	19,364	\$18,346,545	\$18,346,545
Wire Harnesses and Electric Circuit Boards (makers)	33,102	\$91,067,997	\$91,067,997
Marine Antifouling Coatings	2,473	\$1,574,207	\$2,249,336
Articles Used in Manufacturing Equipment, Semiconductor Industry, and HVACR, Power Generating, and Electronic Equipment (makers)	23,521	\$47,586,870	\$52,332,453
Engine Filters for Locomotive and Marine Applications	0	\$0	\$0
Cyanoacrylate Adhesives	0	\$0	\$0
Aviation Hydraulic Fluid (makers)	163	\$453,096	\$453,096
<b>Total<sup>1</sup></b>	<b>405,495</b>	<b>\$335,461,818</b>	<b>\$371,584,745</b>
<i>Note:</i> Total annualized costs have been adjusted down proportionately for PIP (3:1) so as not to include double counting. Where applicable, the use with the highest cost for each NAICS was counted in the total.			

**Table 4-21: Total Annualized Respiratory Protection Costs, by Chemical and Use (Primary Alternative Option) (2022\$)**

Chemical and Use	Number of Workers who need PPE	Annualized Cost, 3% Discount Rate	Annualized Cost, 7% Discount Rate
<b>DecaBDE</b>			
Other DecaBDE-containing Plastic	234,326	\$651,425,712	\$651,425,712
<b>PIP (3:1)</b>			
Lubricants and Greases (except Aerospace and Turbine) (makers)	50	\$34,718	\$47,945
Lubricants & Greases (Aerospace) (makers)	389	\$1,081,996	\$1,081,996
Articles Used in Manufacturing Equipment, Semiconductor Industry, and HVACR, Power Generating, and Electronic Equipment (makers)	31,498	\$77,180,753	\$81,147,257
Wire Harnesses and Electric Circuit Boards (makers)	32,593	\$90,621,871	\$90,621,871
<b>All PIP (3:1)</b>	<b>64,530</b>	<b>\$168,919,338</b>	<b>\$172,899,069</b>
<b>Total</b>	<b>298,856</b>	<b>\$820,345,050</b>	<b>\$824,324,781</b>
<i>Note:</i> Total annualized costs have been adjusted down proportionately for PIP (3:1) so as not to include double counting. Where applicable, the use with the highest cost for each NAICS was counted in the total.			

#### 4.4.3 Dermal Protection

The final rule requires that facilities will provide chemical-resistant gloves that provide an impervious barrier to prevent dermal exposure during expected durations of use and normal conditions of exposure within the workplace.

In addition to costs for compliant gloves, we estimate costs for the facilities to incorporate annual training into their PPE program, as per 29 CFR 1910.132, to ensure that the employee understands how to properly use the equipment they are assigned.

### Training

Owners or operators are required to train employees in proper use, maintenance, and limitations of PPE (29 CFR 1910.132). While owners or operators are only required to retrain employees if they do not demonstrate adequate skill and understanding of the PPE, or if changes in the workplace or types of PPE render the previous training obsolete, EPA assumes that owners or operators will conduct annual retraining. EPA could not identify a source that estimates the time required to conduct training. Because EPA expects that training in proper use of hand protection will be less complex than respirator use training (a minimum of 2 hours), the Agency assumes that hand protection training will require 1 hour per employee. Table 4-22 presents annual training costs per employee.

**Table 4-22: Annual Hand Protection Training Costs per Employee (2022\$)**

Employee Type	Price/ Hour	Number Of Hours Per Employee	Cost/Employee
Worker	\$40.13	1	\$40.13
Manager <sup>1</sup>	\$94.74	0.25	\$23.69
<b>Total Cost of Training per Employee</b>			<b>\$63.82</b>

<sup>1</sup>The number of hours per employee for a manager to conduct training is 15 minutes rather than 1 hour because training is assumed to be conducted in groups of four (Eastern Research Group (ERG) 2003).

### Equipment

Gloves are manufactured to meet the needs of a range of industries and hazards, and thus vary in properties such as material and thickness. For dermal protection against hazardous chemicals, the appropriateness of any given glove will depend on the type of chemical, the type of exposure (e.g. splash protection, immersion), the length of exposure, dexterity requirements, thermal protection, and comfort. There are several commonly used materials to protect against chemical hazards, such as butyl, neoprene, nitrile, and polyvinyl chloride (Occupational Safety and Health Administration (OSHA) 2004; Grainger 2019).

OSHA's Hand Protection Standard does not provide specific guidance on appropriate hand protection for chemicals, instead only stating that "Employers shall base the selection of the appropriate hand protection on an evaluation of the performance characteristics of the hand protection relative to the task(s) to be performed, conditions present, duration of use, and the hazards and potential hazards identified" (29 CFR 1910.138). It is instead recommended that employers select gloves that are most resistant to the specific chemicals being used based on manufacturers' chemical resistance guides (Occupational Safety and Health Administration (OSHA) 2004; Grainger 2019). This is particularly important because gloves made of the same material but from different manufacturers may perform differently for a given chemical. Similarly, a material that is suitable for one chemical may not provide adequate protection against another chemical (Argonne National Laboratory 2014). For the purpose of this analysis, EPA assumes that companies will choose nitrile gloves. Nitrile gloves are often used as a general-purpose glove that provides protection against chlorinated solvents, as well as oils, greases, petroleum products, acids, caustics, and alcohols. To the extent that companies choose other types of gloves, costs will be more or less than estimated.

For disposable gloves, the number of pairs used per day will depend on the type of work being performed. Depending on the industry, an employee may work with the chemical consistently throughout the day or

they may only come into contact with the chemical once per day or once every few days. For cases where a worker will come into contact with the chemical once per day or less, a lower bound assumption is one pair of gloves per day. For cases where a worker may be in constant contact with the chemical throughout the day, it may be assumed that the worker will change gloves every 2 hours (or 4 pairs per 8-hour workday), assuming that is the average length of time a worker will work with the chemical before taking a break or switching tasks. To be conservative, EPA assumes that the worker will change gloves every 2 hours, for 260 workdays per year.

Estimated unit costs for nitrile gloves were developed by averaging the prices gathered from internet research of popular PPE distributors in 2022, as shown in Appendix E, Table E-2. Table 4-23 presents unit costs estimates for gloves. Useful life defines the schedule used to discount each cost component before the estimates are annualized over 30 years. Total annual costs of dermal protection are the sum of each applicable unit cost divided by its useful life.

<b>Table 4-23: Dermal Protection Unit Costs per worker (2022\$)</b>			
<b>Equipment Type</b>	<b>Unit cost</b>	<b>Useful Life (Year)</b>	<b>Annual Cost</b>
Nitrile Gloves (pair)	\$0.17	0.000962	\$174

#### **Total Annualized Dermal Protection Costs**

Total annual costs are shown in Table 4-24.

<b>Table 4-24: Total Annual Dermal Protection Costs, per worker (2022\$)</b>			
<b>Equipment Type</b>	<b>Annual Equipment Costs</b>	<b>Annual Training Costs</b>	<b>Total Annual Costs</b>
Nitrile Gloves (pair)	\$174	\$64	\$238

Annualized dermal protection costs will depend on the number of years during which equipment use takes place. Dermal protection costs from Table 4-24 were annualized at both 3% and 7% discount rates over 30 years for the number of years until prohibition that the final and alternative options cover. These costs are provided in Table 4-25.

<b>Table 4-25: Annualized Dermal Protection Costs for Various Years of Use (2022\$)</b>			
<b>Equipment Type</b>	<b>Years of Use</b>	<b>Cost Annualized at 3%</b>	<b>Cost Annualized at 7%</b>
Nitrile Gloves (pair)	5	\$54	\$78
Nitrile Gloves (pair)	10	\$102	\$133
Nitrile Gloves (pair)	15	\$142	\$173
Nitrile Gloves (pair)	20	\$177	\$201
Nitrile Gloves (pair)	30	\$238	\$238

Appendix F, Table F-2, sums the costs shown in Table 4-25 for each industry sector under each use, considering the percent of employees who may be affected and baseline compliance rate (affected workers and compliance rates were discussed in Section 4.4.1). Table 4-26 and Table 4-27 show the dermal protection costs from totaled for each regulatory option (final and primary alternative options, respectively).

**Table 4-26: Total Annualized Dermal Protection Costs, by Chemical and Use (Final Option) (2022\$)**

Chemical and Use	Annualized Cost, 3% Discount Rate	Annualized Cost, 7% Discount Rate
<b>DecaBDE</b>		
Plastic Shipping Pallets	\$0	\$0
Replacement Parts for Aerospace Vehicles (makers)	\$0	\$0
Replacement Parts for Motor Vehicles (makers)	\$0	\$0
<b>PIP (3:1)</b>		
Lubricants & Greases (except Aerospace and Turbine) (makers)	\$7,678	\$7,678
Lubricants and Greases (Aerospace and Turbine) (makers)	\$232	\$326
New and Replacement Parts for Motor Vehicles (makers)	\$24,334,986	\$24,997,923
New and Replacement Parts for Aerospace Vehicles (makers)	\$4,167,396	\$4,167,396
Wire Harnesses and Electric Circuit Boards (makers)	\$6,971,194	\$6,971,194
Marine Antifouling Coatings	\$0	\$0
Articles Used in Manufacturing Equipment, Semiconductor Industry, and HVACR, Power Generating, and Electronic Equipment	\$1,548,471	\$1,548,471
Engine Filters for Locomotive and Marine Applications	\$0	\$0
Cyanoacrylate Adhesives	\$0	\$0
Aviation Hydraulic Fluid (makers)	\$3,849	\$3,849
<b>Total<sup>1</sup></b>	<b>\$37,033,806</b>	<b>\$37,696,837</b>
<b>Note:</b> Total annualized costs have been adjusted down proportionately for PIP (3:1) so as not to include double counting. Where applicable, the use with the highest cost for each NAICS was counted in the total.		

**Table 4-27: Annualized Dermal Protection Costs, by Chemical and Use (Primary Alternative Option) (2022\$)**

Chemical and Use	Annualized Cost, 3% Discount Rate	Annualized Cost, 7% Discount Rate
<b>DecaBDE</b>		
Other DecaBDE-containing Plastic	\$3,329,684	\$3,329,684
<b>PIP (3:1)</b>		
Lubricants and Greases (except Aerospace and Turbine) (makers)	\$230	\$324
Lubricants & Greases (Aerospace) (makers)	\$7,701	\$7,701
Wire Harnesses and Electric Circuit Boards (makers)	\$7,873,223	\$7,873,223
Articles Used in Manufacturing Equipment, Semiconductor Industry, and HVACR, Power Generating, and Electronic Equipment	\$3,918,935	\$3,918,935
<b>All PIP (3:1)</b>	<b>\$11,800,090</b>	<b>\$11,800,184</b>
<b>Total</b>	<b>\$15,129,774</b>	<b>\$15,129,868</b>
<b>Note:</b> Total annualized costs have been adjusted down proportionately for PIP (3:1) so as not to include double counting. Where applicable, the use with the highest cost for each NAICS was counted in the total.		

#### 4.4.4 PPE Documentation

EPA requires that owners and operators document respiratory protection used and PPE program implementation. As described in Section 2.4.1 and 2.4.3, the rule requires that owners and operators document in the PPE program the following information, as applicable:

- (A) The name, workplace address, work shift, job classification, and work area of each person reasonably likely to directly handle the chemical (decaBDE or PIP (3:1)) or handle equipment or materials on which the chemical may present and the type of PPE selected to be worn by each of these persons;
- (B) The basis for PPE selection (e.g., demonstration based on permeation testing or manufacturer specifications that each item of PPE selected provides an impervious barrier to prevent exposure

during expected duration and conditions of exposure, including the likely combinations of chemical substances to which the PPE may be exposed in the work area); and  
 (C) Appropriately sized PPE and training on proper application, wear, and removal of PPE, and proper care/disposal of PPE.

EPA assumes that the burden to develop this documentation is similar to the estimates for developing a written exposure control document from OSHA's *Final Economic Analysis and Final Regulatory Flexibility analysis for Occupational Exposure to Respirable Crystalline Silica* (Occupational Safety and Health Administration (OSHA) 2016b) assumes that a supervisor (manager) will develop a written plan. OSHA estimates that it will take 1 hour to develop the plan for establishments with fewer than 20 employees, 4 hours for establishments between 20 and 499 employees, and 16 hours for establishments with more than 500 employees. This analysis assumes that the plan will be developed by a certified industrial hygienist. The per-company cost at 3 and 7 percent discount rates are presented in Table 4-28.

**Table 4-28: One-time Cost of Developing PPE Documentation, per company**

Facility Type	Hours	Industrial Hygienist Labor (at \$68.41 per hour)	Annualized (3% Discount Rate)	Annualized (7% Discount Rate)
Small Manufacturing (fewer than 20 employees)	1	\$68	\$3	\$5
Medium Manufacturing (20 to 499 employees)	4	\$274	\$13	\$20
Large Manufacturing (more than 500 employees)	16	\$1,095	\$53	\$82

As shown in Appendix E, EPA used SUSS data to determine the number of firms in each of the facility size types (small, medium, and large) for each of the affected NAICS for each chemical and use. EPA then applied the appropriate cost from Table 4-28. The summed costs for each regulatory option are shown in Table 4-29 for the final option, and Table 4-30 for the primary alternative option.

**Table 4-29: Annualized PPE Documentation Costs, by Chemical and Use (Final Option) (2022\$)**

Chemical and Use	Total Annualized Cost, 3% Discount Rate	Total Annualized Cost, 7% Discount Rate
<b>DecaBDE</b>		
Plastic Shipping Pallets	\$13	\$20
Replacement Parts for Aerospace Vehicles (makers)	\$0	\$0
Replacement Parts for Motor Vehicles (makers)	\$0	\$0
<b>PIP (3:1)</b>		
Lubricants and Greases (except Aerospace and Turbine) (makers)	\$64	\$100
Lubricants & Greases (Aerospace) (makers)	\$326	\$505
New and Replacement Parts for Motor Vehicles (makers)	\$92,521	\$144,633
New and Replacement Parts for Aerospace Vehicles (makers)	\$23,368	\$36,407
Wire Harnesses and Electric Circuit Boards (makers)	\$20,139	\$31,390
Marine Antifouling Coatings	\$53	\$82
Articles Used in Manufacturing Equipment, Semiconductor Industry, and HVACR, Power Generating, and Electronic Equipment (makers)	\$13,724	\$21,440
Engine Filters for Locomotive and Marine Applications	\$3	\$5
Cyanoacrylate Adhesives	\$52	\$82
Aviation Hydraulic Fluid (makers)	\$141	\$219
<b>All PIP (3:1)</b>	<b>\$150,393</b>	<b>\$234,863</b>
<b>Total<sup>1</sup></b>	<b>\$150,406</b>	<b>\$234,883</b>
<b>Note:</b> Total annualized costs have been adjusted down proportionately for PIP (3:1) so as not to include double counting. Where applicable, the use with the highest cost for each NAICS was counted in the total.		

**Table 4-30: Annualized PPE Documentation Costs, by Option (Primary Alternative Options) (2022\$)**

Chemical and Use	Total Annualized Cost, 3% Discount Rate	Total Annualized Cost, 7% Discount Rate
<b>DecaBDE</b>		
Other DecaBDE-containing Plastic	\$89,525	\$139,885
<b>PIP (3:1)</b>		
Lubricants and Greases (except Aerospace and Turbine) (makers)	\$85	\$132
Lubricants & Greases (Aerospace) (makers)	\$397	\$614
Articles Used in Manufacturing Equipment, Semiconductor Industry, and HVACR, Power Generating, and Electronic Equipment (makers)	\$20,758	\$32,381
Wire Harnesses and Electric Circuit Boards (makers)	\$21,546	\$33,578
<b>All PIP (3:1) Alternative Options</b>	<b>\$42,786</b>	<b>\$66,705</b>
<b>Total<sup>1</sup></b>	<b>\$132,311</b>	<b>\$206,590</b>
<b>Note:</b> Total annualized costs have been adjusted down proportionately for PIP (3:1) so as not to include double counting. Where applicable, the use with the highest cost for each NAICS was counted in the total.		

#### 4.4.5 Total Worker Protection Costs

Table 4-31 and Table 4-32 show the total worker protection (PPE) costs under the final and primary alternative regulatory options, respectively.

**Table 4-31: Total PPE Costs, by Chemical and Use (Final Option)**

Chemical and Use	Annualized Cost, 3% Discount Rate				Annualized Cost, 7% Discount Rate			
	Respiratory	Dermal	Documentation	TOTAL	Respiratory	Dermal	Documentation	TOTAL
<b>DecaBDE</b>								
Plastic Shipping Pallets	\$0	\$0	\$13	\$13	\$0	\$0	\$20	\$20
Replacement Parts for Aerospace Vehicles (makers)	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Replacement Parts for Motor Vehicles (makers)	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
<b>PIP (3:1)</b>								
Lubricants and Greases (except Aerospace and Turbine) (makers)	\$90,277	\$232	\$64	\$90,573	\$107,300	\$326	\$100	\$107,726
Lubricants & Greases (Aerospace) (makers)	\$1,029,967	\$7,678	\$326	\$1,037,971	\$1,029,967	\$7,678	\$505	\$1,038,150
New and Replacement Parts for Motor Vehicles (makers)	\$175,312,859	\$24,334,986	\$92,521	\$199,740,366	\$205,998,051	\$24,997,923	\$144,633	\$231,140,607
New and Replacement Parts for Aerospace Vehicles (makers)	\$18,346,545	\$4,167,396	\$23,368	\$22,537,309	\$18,346,545	\$4,167,396	\$36,407	\$22,550,348
Wire Harnesses and Electric Circuit Boards (makers)	\$91,067,997	\$6,971,194	\$20,139	\$98,059,330	\$91,067,997	\$6,971,194	\$31,390	\$98,070,581
Marine Antifouling Coatings	\$1,574,207	\$0	\$53	\$1,574,260	\$2,249,336	\$0	\$82	\$2,249,418
Articles Used in Manufacturing Equipment, Semiconductor Industry, and HVACR, Power Generating, and Electronic Equipment (makers)	\$47,586,870	\$1,548,471	\$13,724	\$49,149,065	\$52,332,453	\$1,548,471	\$21,440	\$53,902,364
Engine Filters for Locomotive and Marine Applications	\$0	\$0	\$3	\$3	\$0	\$0	\$5	\$5
Cyanoacrylate Adhesives	\$0	\$0	\$52	\$52	\$0	\$0	\$82	\$82
Aviation Hydraulic Fluid (makers)	\$453,096	\$3,849	\$141	\$457,086	\$453,096	\$3,849	\$219	\$457,164
<b>All PIP (3:1)</b>	<b>\$335,461,818</b>	<b>\$37,033,806</b>	<b>\$150,393</b>	<b>\$372,646,017</b>	<b>\$371,584,745</b>	<b>\$37,696,837</b>	<b>\$234,863</b>	<b>\$409,516,445</b>
<b>TOTAL</b>	<b>\$335,461,818</b>	<b>\$37,033,806</b>	<b>\$150,406</b>	<b>\$372,646,030</b>	<b>\$371,584,745</b>	<b>\$37,696,837</b>	<b>\$234,883</b>	<b>\$409,516,465</b>

**Table 4-32: Total PPE Costs, by Chemical and Use (Primary Alternative Options)**

Chemical and Use	Annualized Cost, 3% Discount Rate				Annualized Cost, 7% Discount Rate			
	Respiratory	Dermal	Documentation	TOTAL	Respiratory	Dermal	Documentation	TOTAL
<b>DecaBDE</b>								
Other DecaBDE-containing Plastic	\$651,425,712	\$3,329,684	\$89,525	<b>\$654,844,921</b>	\$651,425,712	\$3,329,684	\$139,885	<b>\$654,895,281</b>
<b>PIP (3:1)</b>								
Lubricants and Greases (except Aerospace and Turbine) (makers)	\$34,718	\$230	\$85	<b>\$35,033</b>	\$47,945	\$324	\$132	<b>\$48,401</b>
Lubricants & Greases (Aerospace) (makers)	\$1,081,996	\$7,701	\$397	<b>\$1,090,094</b>	\$1,081,996	\$7,701	\$614	<b>\$1,090,311</b>
Articles Used in Manufacturing Equipment, Semiconductor Industry, and HVACR, Power Generating, and Electronic Equipment (makers)	\$90,621,871	\$7,873,223	\$21,546	<b>\$98,516,640</b>	\$90,621,871	\$7,873,223	\$33,578	<b>\$98,528,672</b>
Wire Harnesses and Electric Circuit Boards (makers)	\$77,180,753	\$3,918,935	\$20,758	<b>\$81,120,446</b>	\$81,147,257	\$3,918,935	\$32,381	<b>\$85,098,573</b>
<b>All PIP (3:1) Uses</b>	<b>\$168,919,338</b>	<b>\$11,800,090</b>	\$42,786	<b>\$180,762,214</b>	<b>\$172,899,069</b>	<b>\$11,800,184</b>	\$66,705	<b>\$184,765,598</b>
<b>TOTAL</b>	<b>\$820,345,050</b>	<b>\$15,129,774</b>	<b>\$132,311</b>	<b>\$835,607,135</b>	<b>\$824,324,781</b>	<b>\$15,129,868</b>	<b>\$206,590</b>	<b>\$839,661,239</b>

## 4.5 Signage Costs

Under the final option, firms are required to post warning signs where decaBDE-containing plastic pallets are being recycled. EPA is finalizing a signage requirement in the area where plastic pallets are recycled. This sign will provide notice to workers that PPE is required to be worn during recycling of plastic shipping pallets, which will reduce potential exposures to decaBDE. A sign must be posted at every entry point into the regulated area that clearly, prominently, in multiple languages as appropriate, and in an easily readable font size, contain following text: “Decabromodiphenyl ether (DecaBDE) (CASRN 1163-19-5), a chemical that has been identified as persistent, bioaccumulative, and toxic (PBT) chemical by the U.S. Environmental Protection Agency, may be present in this regulated area. All persons who process plastic shipping pallets, including recycling, are required to wear personal protective equipment, per regulations at 40 CFR 751.405(e).”

To estimate signage costs, unit costs were retrieved from the RS Means 2017 dataset (RS Means 2017). The material cost is indexed to 2022 using the BLS CPI for all urban consumers, while labor costs are calculated by combining the burden from RS Means with the technical wage rate. There is only one firm (iGPS) known to recycle pallets and EPA assumes they will post 2 signs. EPA also assumes each sign will be replaced every five years during the period of the analysis, leading to a total of 12 signs.

**Table 4-33: Posting Signs Cost Estimate, Annualized (2022\$)**

Labor or Material	Material Cost	Labor Hours	Source	Number of Signs	Cost in \$2022
Labor	0	0.167	RS Means 02 83 19.22 0050	12	\$27.77
Material	8.65	0	RS Means 02 83 19.22 0050	12	\$20.65
<b>Total Annualized Cost (3%):</b>					<b>\$10.29</b>
<b>Total Annualized Cost (7%):</b>					<b>\$11.44</b>

## 4.6 Export Notification

EPA is requiring export notification for all persons intending to export decaBDE-containing wire and cable insulation for nuclear power generation facilities. Exporters are required to notify EPA under TSCA Section 12(b) and the provisions of subpart D in 40 CFR part 707. The 2020 TSCA Section 12(b) ICR (U.S. Environmental Protection Agency (EPA) 2020d), estimated the annual export notification cost for an exporter under the one-time export notification requirement. These costs include the cost to the exporter of compiling a list of their products that are subject to TSCA Section 12(b) requirements, writing or revising an export notification letter to EPA, checking the outgoing shipments, and sending the notification letters with the associated shipping costs.

For the purpose of this section, a notice is a package received by the EPA by one firm. Each notice may contain several products and/or countries. A notice subsequently becomes a letter of notification that EPA issues to a foreign government. As firms are given the opportunity to voluntarily submit reports electronically rather than by paper, burden estimates are based on the expectation that 63% of reports would be submitted electronically. This expectation is based on the trend witnessed for TSCA section 8(e) electronic submissions in which firms can volunteer to submit by paper or electronically. Given the limitations placed on decaBDE-containing articles, EPA assumes the export notification activities described in the following subsections will only need to be completed in the first year.

Most of the underlying data and assumptions in this section come from the 2020 TSCA Section 12(b) ICR, ICR No.: 0795.16 [Information Collection Request for] Notification of Chemical Exports - TSCA Section 12(b) Supporting Statement for Request for OMB Review under the Paperwork Reduction Act (U.S. Environmental Protection Agency (EPA) 2020d), with updating to current costs.

#### **4.6.1 Compile List**

Exporters need only check to determine which products exported by the firm are subject to this requirement. Given the limitations placed on decaBDE-containing articles, EPA assumes this activity will only need to be completed in the first year. Updating the list is estimated to take an average of one hour of technical time (which may also include some proportion of legal time). This could vary depending on the number of products from two hours per year up to two hours per month of technical time (which may also include some proportion of legal time). This will vary depending on the number of products exported by the firm and the number of their products subject to the requirement. EPA estimates unit burden for compiling the list estimated at an average of 9.3 hours of technical time per firm per year.

#### **4.6.2 Write or Revise Letter**

Firms that export products subject to this requirement must prepare an export notice to send to EPA. EPA expects that the time needed for initial preparation of the export notice probably varies depending on whether the firm has prior experience with this program, but this step is estimated to take an average of one hour of technical time (which may also include some proportion of legal time) per year for each firm subject to TSCA section 12(b) reporting.

#### **4.6.3 CBI Substantiation**

Firms are required to provide CBI substantiation for any claims of data confidentiality. When estimating this burden, EPA accounts for the burden associated with the substantiation of ChemID and non-ChemID claims. CBI substantiation for ChemID elements involves providing answers to questions concerning reasons that CBI status of chemical substance is to be maintained. CBI substantiation for ChemID claim is estimated to take 1.15 hours per report, including both technical and managerial. A firm will claim CBI for ChemID elements when submitting a chemical that is not included in the 12(b) list. However, decaBDE is on the 12(b) list because it is subject to TSCA section 6(h). Therefore, no CBI claims are expected.

#### **4.6.4 Check Orders and Send Notices**

The firms that export products subject to this requirement must check outgoing shipments against the list of their products described above. A form letter notifying EPA is either printed out or electronically prepared detailing where the shipment is going if it is the first shipment of the year to the importing country. This process is estimated to take an estimated zero hours for the 63% of submissions received electronically, as opposed to the 6.5 hours of clerical time per firm for the remaining 37% of submissions by paper.<sup>29</sup> Therefore, on average, the burden is  $0.63*0 + 0.37*6.5 = 2.4$  hours per notice.

#### **4.6.5 Mailing Costs**

As noted above, 37% of regulated companies are estimated to submit by paper, and so will incur mailing costs for export notifications delivered to EPA. Notifications are assumed shipped via the U.S. Postal

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<sup>29</sup> In accordance with methodology for e-reporting, the activities outside of electronic reporting are considered to be absorbed in the efficiencies of e-reporting overall.

Service (USPS) as first-class registered mail with a return receipt. The estimated per-shipment and annual mailing costs incurred by individual submitters are detailed in Table 4-34.

<b>Table 4-34: Derivation of Total Mailing Cost per Export Notification (2022\$)</b>	
<b>Postal Service</b>	<b>Cost</b>
Registered Mail, with \$0 declared value	\$14.65
Return Receipt (mail)	\$3.25
Postage, regular First Class, up to 1 ounce	\$0.60
<b>Total Cost per Export Notice</b>	<b>\$18.50</b>

**Notes:** The mailing method comes from (U.S. Environmental Protection Agency (EPA) 2022).  
**Source:** 2022 mailing rates found on Stamps.com (Stamps.com Inc. 2022).

The total cost per notice as derived in Table 4-34 is scaled by 37% for the average mailing cost per exporter per notice of \$18.50.

#### 4.6.6 Total Export Notification Costs

The burdens and associated costs for each notification activity, as described in the previous sections, are summarized in Table 4-35.

<b>Cost Component</b>	<b>Technical Labor (at \$83.14/hour)</b>		<b>Clerical Labor (at \$40.13/hour)</b>		<b>Total</b>	
	<b>hours</b>	<b>cost</b>	<b>hours</b>	<b>cost</b>	<b>hours</b>	<b>cost</b>
	9.3	\$773.20	0	\$0.00	9.3	\$773.20
Write Letter	1	\$83.14	0	\$0.00	1	\$83.14
Check Order and Send Notices	0	\$0.00	2.4	\$96.31	2.4	\$96.31
Mailing Costs						\$6.85
<b>TOTAL</b>					<b>12.7</b>	<b>\$959.50</b>

Since each notice may contain several products and/or countries, EPA assumes that each company will send only one notice as a result of this rulemaking. Table 4-38 provides the total cost for export notifications for each chemical and use. This is likely an overestimate, as each company in the identified NAICS may not export decaBDE-containing products.

<b>Chemical and Use</b>	<b>Number of Companies</b>	<b>Total Cost (at \$959 per Notice)</b>	<b>Annualized at 3%</b>	<b>Annualized at 7%</b>
<b>DecaBDE</b>				
Wire and Cable Insulation	1	\$959	\$47	\$72
<b>All DecaBDE</b>	<b>1</b>	<b>\$959</b>	<b>\$47</b>	<b>\$72</b>

## 4.7 Engineering Controls

EPA is requiring engineering controls for the use of PIP (3:1) in the manufacturing of cyanoacrylate adhesives. According to stakeholders, the production process using PIP (3:1) is carried out in an automated batch distillation plant and in a well-ventilated closed system (Henkel Corporation 2019). EPA is requiring engineering controls for the use of PIP (3:1) as an intermediate in the production of cyanoacrylate adhesives such that the processing of PIP (3:1) must take place in a closed loop system and general and local area ventilation must be provided. In codifying these measures, EPA does not intend to supplant OSHA's requirements at 29 CFR 1910.134(a)(1) which require engineering controls to prevent

atmospheric contamination. Given the OSHA requirements that already exist, and the controls already in place by the affected company, EPA believes that this requirement will incur no incremental costs.

## 4.8 Labelling Costs

One of the requirements under the primary alternative option would require labeling of articles or parts containing the regulated chemical: for all recycled plastic articles containing decaBDE, a label would be required.

For labeling of plastic articles, a sticker label may not be appropriate. For this analysis, EPA assumes that labeling of the product's packaging is sufficient. The following factors must be considered in determining the cost impact of a package label change.

For EPA's previous *Economic Analysis of Regulation of Methylene Chloride, Paint and Coating Remover under TSCA Section 6(a)* (U.S. Environmental Protection Agency (EPA) 2019a), EPA surveyed five blenders of aerosol spray degreasers that contain trichloroethylene on what types of costs they would incur for amending labels to add additional precautions and directions to their products. Aerosol spray degreasing products are used in consumer, commercial, and industrial sectors. Respondents reported potential costs associated with disposal of pre-existing labels and packaging, graphic design, reviewing proofs, creating electronic files used to engrave the printing plates, and changing the printing plates. None of the respondents reported any incremental recurring costs for labeling. One blender estimated minimal labor costs of approximately \$100 to \$200 per label for graphic design changes, and \$600 for the plate change<sup>30</sup>, for total one-time costs ranging from approximately \$700 to \$800 per product (2014\$). EPA assumes that a similar effort will be required to modify labels on the products regulated under the final rule; given the simplicity of the required change, EPA expects that the costs will be closer to the lower estimate. EPA updated these costs to 2022\$ using an inflation factor developed from the Consumer Price Index for All items in U.S. city average, all urban consumers, not seasonally adjusted (U.S. Bureau of Labor Statistics (BLS) 2023a). Table 4-37 shows these estimated unit costs in 2022\$. EPA expects that all labelling costs will be one-time initial costs (i.e., incurred in the first year of rule compliance).

**Table 4-37: Product Labeling Cost Estimate, per product (2022\$) (first year)**

Estimate Type	Total Labor Cost per SKU (2014\$)	Total Material Cost per SKU (2014\$)	Total Labeling Cost per SKU (2022\$)
Low estimate	\$100	\$600	\$865
High estimate	\$200	\$600	\$989
Average			\$927

Source: (U.S. Environmental Protection Agency (EPA) 2019a)  
Note: 2014\$ costs inflated to 2022\$ using (U.S. Bureau of Labor Statistics (BLS) 2023a)

**Table 4-38: Total Labeling Costs, by Chemical and Use (Primary Alternative Option) (2022\$)**

Use	Number of Firms	Labeling Cost per SKU	SKUs per company	Total Labeling Cost (First year)	Annualized (3%)	Annualized (7%)
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<sup>30</sup> New printing plates or cylinders would need to be engraved with the redesigned label. EPA assumes only one plate is needed because the label change will only need one color.

DecaBDE						
Other DecaBDE-containing Plastic	8,894	\$927	1	\$8,246,119	\$400,288	\$614,967
			<b>TOTAL</b>		<b>\$400,288</b>	<b>\$614,967</b>

## 4.9 Unquantified Costs and Uncertainty

While the previous sections of this chapter describe the quantified costs of the Final Rule, there are cases in which certain costs are not quantified or uncertainty in the costs is present. The following section discusses these unquantified costs, as well as other uncertainties in the cost estimates.

### 4.9.1 Costs to Prevent Releases

Under the final option, EPA prohibits the release of decaBDE to water during manufacture, processing, distribution in commerce.

Under this option, all persons are required to follow all applicable regulations for preventing the release of decaBDE and decaBDE-containing products to water during use.

As mentioned in the Exposure and Use Assessment, Toxic Release Inventory (TRI) data show a decrease in releases that are reported in each industry section using decaBDE. The number of manufacturing facilities, textile manufacturing facilities, wire and cable manufacturing facilities, and other facilities reporting TRI releases had decreased from several dozen to only one manufacturer and 23 other facilities in 2016 (U.S. Environmental Protection Agency (EPA) 2021c). Specifically, the one manufacturer that released water prior to 2012 is now prohibited from manufacturing under the 2021 decaBDE final rule. According to 2021 TRI data, there were zero releases of decaBDE to water (U.S. Environmental Protection Agency (EPA) 2021c).

Furthermore, the lifecycle assessment of iGPS plastic pallets, one of the identified products containing decaBDE, indicates that water use is negligible. The document states that “water consumption during plastic pallet manufacturing operations is minimal. The only water consumption during this process is for employee use (water fountains, restrooms, etc.) and for equipment cleaning.” (iGPS 2021) No specific wastewater effluent data was provided by iGPS.

For the reasons described above, EPA contends there are no known releases to water. Therefore, this analysis assumes costs to industry associated with releases to water to be zero.

### 4.9.2 Regulatory Threshold Level

Multiple commenters on the proposed rule expressed difficulty in tracking trace amounts of PIP (3:1) in parts and articles (SEMI 2024, American Chemistry Council 2024, American Chemistry Council 2024, Chemical Users Coalition 2024, Air-Conditioning Heating and Refrigeration Institute 2024, Semiconductor Industry Association (SIA) 2024, Association of Equipment Manufacturers (AEM) 2024, Consumer Technology Association 2024). One commenter, for example, notes the challenge of guaranteeing that no decaBDE or PIP (3:1) has been added by upstream manufacturers (SEMI 2024). They note that a regulatory threshold level would help guide due diligence efforts. Another commenter notes that without a threshold level, regulated entities would not know whether they are in compliance because detection levels of chemicals are constantly being reduced. In response to comments, EPA is establishing a regulatory threshold level of 0.1% for unintentional quantities in products and articles, not including any amounts present due to excluded or phased out uses for decaBDE and PIP (3:1). EPA acknowledges that these costs might be incurred without a regulatory threshold. However, EPA believes

the threshold is sufficient to provide companies with sufficient guidance and curtail incremental due diligence costs.

#### **4.9.3 Manufacture by date**

Some public commenters on the proposed rule noted the lag between when an article is manufactured and when it is distributed and used in the market (Japan Electronics and Information Technology Industries Association (JEITA) 2023, Association of Home Appliance Manufacturers 2024, Association for Advancing Automation (A3) 2024, Chemical Users Coalition 2024, AMT- The Association For Manufacturing Technology 2024, Air-Conditioning Heating and Refrigeration Institute 2024, Consumer Technology Association 2024). A commenter noted that the date over which manufacturers have the most control of in the manufacturing and distribution chain is the “manufactured by” date (Consumer Technology Association 2024). In response to these comments, as detailed in the preamble for this final rule, EPA does not believe, unless otherwise specified, that products and articles containing PBT chemicals should continue to be distributed without end, and therefore is not adopting a generally applicable “manufactured by” provision. It would be very difficult, if not impossible, for purchasers and compliance inspectors to tell the difference between most products based on when they were produced, and thus EPA is establishing deadlines by which products and articles may no longer be processed and distributed unless otherwise excluded for practicability reasons. This approach discourages stockpiling while still allowing meaningful flexibilities with alternative compliance deadlines where such an alternative is appropriate.

EPA acknowledges that retailers and distributors may keep some amount of stock on hand and may not have ways to track which inventory may be subject to a prohibition. EPA agrees with commenters that it would not be practicable to force retailers to dispose of stocks, disrupting supply chains and potentially be costly. Hence, for practicability reasons EPA is providing longer “sell through” dates for distribution of articles containing PIP (3:1) for those articles with a compliance date of October 31, 2024. Instead, EPA has finalized specific phase-in prohibitions or exclusions for certain PBT-containing articles and finalized an exclusion solely for the purpose of repair and maintenance of an existing article. However, to discourage stockpiling, EPA is not providing for a sell-through provision for those articles covered by a phase-in prohibition, in particular for new and replacement parts. In such cases, EPA believes it is practicable for companies to manage supply chains and stocks during the phase-ins to significantly reduce disruptions or the need to dispose of PIP (3:1)-containing items.

The provisions EPA is finalizing today do not directly prohibit the manufacturing, processing, distribution in commerce, and use of equipment and other finished goods, rather the provisions apply to the new and replacement parts that such equipment and finished goods may include. This analysis does not quantify the costs of any lost inventory beyond what is allowed for by the Final Rule.

#### **4.9.4 Prohibition Costs**

##### **Supply Chain Analysis and Testings**

Multiple commenters (Boeing 2024, AMT- The Association For Manufacturing Technology 2024, Consumer Technology Association 2024) note the difficulty in detecting the presence of PIP (3:1) in complex supply chains. For example, one public commenter in the electronics industry noted that surveying a supply chain is a substantial undertaking. They stated that electronic finished goods manufacturers have anywhere from 2,500 to upwards of well over 5,000 suppliers. Each of those suppliers may provide the components that go into upwards of 5,000 finished goods on average.

According to the commenter, the two together translates to upwards of 100,000 or more individual components that go into those finished goods sourced from various suppliers.

As discussed in Section 4.3, companies need to conduct testing to ensure newly formulated products are safe and function as intended. Products in some industries are required to meet regulatory performance and safety standards as well. Multiple commenters highlighted these testing costs (SEMI 2024, National Marine Manufacturers Association 2024, Eastman Chemical Company 2024). One commenter (Eastman Chemical Company 2024) summarized the process: “After the identification of possible alternatives through extensive research and development activities, product testing must then be performed. Following that, regulatory approvals as required by the Federal Aviation Association (FAA) and the varied Military Specifications must be met and certified. Finally, Original Equipment Manufacturers (OEM) approvals must be sought through further testing and research before circulation into use.” Another commenter (National Marine Manufacturers Association 2024) noted that this can be particularly burdensome to small businesses.

While supply chain analysis and testing costs are included in the cost estimates and EPA believes these estimates reflect the reasonably ascertainable economic consequences of the rule, there is a possibility that supply chain and testing costs higher than projected. Those additional costs, were they to occur, are not quantified in the cost analysis.

### **Loss of Revenue**

EPA established phase-in periods intended to be practicable for industry to find, test, and implement suitable alternatives. If industry is unable to find alternatives that do not contain PIP (3:1), there could be loss of revenue related to the sale of those products. In some cases, substitute products that do not contain PIP (3:1) are already available. In those cases, lost revenue of PIP (3:1)-containing products might be offset at a societal level by use of non-PIP (3:1)-containing products. However, in other cases there are no alternatives currently available. There are also cases where the shift is more complicated, for example if PIP (3:1) is used in an article that is specifically intended to be part of a larger complex article (e.g. vehicles or manufacturing equipment). This scenario is discussed in the subsequent Replacement Parts section (4.9.5). Public commenters on the proposed rule suggested there would be considerable costs and disruption if industry is not able to use PIP (3:1) and viable alternatives are still not in place (Boeing 2024, AMT- The Association For Manufacturing Technology 2024, Consumer Technology Association 2024). This analysis does not include the costs of this prospective scenario.

### **Indirect Costs**

EPA notes that while the direct costs associated with this rule (Section 4.2 - 4.8) are borne largely by the companies that make the products or articles containing a regulated chemical, these costs will likely be passed on through price increases experienced by the consumer. In many cases, the products affected by this regulation are highly specific (e.g., aviation hydraulic fluid) and thus price inelastic with respect to demand. Therefore, increases in price are more likely to be passed on to the consumer than to be borne by the processor as a loss in revenue or a shift in market volume. However, given the wide range of products, number of end-users and variability in consumer behavior, it is not possible to attribute these higher costs to end-users in this analysis.

#### **4.9.5 Replacement Parts**

A number of public commenters (Japan Electronics and Information Technology Industries Association (JEITA) 2023, SEMI 2024, Outdoor Power Equipment Institute 2024, Boeing 2024, Association for Advancing Automation (A3) 2024, Chemical Users Coalition 2024, Nuclear Energy Institute 2024, AMT- The Association For Manufacturing Technology 2024, Air-Conditioning Heating and Refrigeration

Institute 2024, Semiconductor Industry Association (SIA) 2024, Consumer Technology Association 2024) posited that PIP (3:1)-containing replacement parts are critical to additional sectors beyond motor and aerospace vehicles. For example, a commenter in the manufacturing industry argued that once the ban becomes effective, more than 50 percent of U.S. capacity to manufacture could be idled due to the inability to service the equipment with replacement parts that do not include PIP (3:1). They estimated that there is approximately \$175 billion of capital stock in manufacturing technology currently in U.S. plants, and that while the percentage of the stock impacted or containing PIP (3:1) is unknown, they believe it is substantial. As such, EPA instituted longer phase-ins for replacement parts, with the intent that firms will be able to continue to service in-use equipment designed with PIP (3:1)-containing parts. EPA believes that these phase-ins are sufficient. However, in the event that these longer phase-in periods for replacement parts are not adequate and result in some loss of the use of products in inventory, these additional costs are not quantified in this analysis.

#### **4.9.6 Downstream Notification**

As noted in Section 2.4.3, EPA is also amending the downstream notification statement that must accompany shipments of PIP (3:1) or PIP (3:1) containing products to conform to the terms of the prohibitions in the final rule. EPA is providing a 3-month transition period to update SDS sheets and an 18-month transition period for updating labels. EPA believes that this transition period will allow time to clear product with old labels through channels of trade. During the 3-month transition period, downstream notification under 40 CFR 751.407(e)(1) and (2) is still required; entities may use the new information provided in new 40 CFR 751.407(e)(3) or existing notification consistent with the restrictions described in this subpart. During the 15-month period between the SDS revision date and the label revision date, manufacturers, processors or distributors are required to provide the updated SDS with the “new” information when distributing products with the “old” label.

Under the 2021 PBT final rule, each manufacturer, processor, or distributor of PIP (3:1) for any use must, prior to or concurrent with the shipment, notify companies to whom PIP (3:1) is shipped, in writing, of the prohibitions on processing and distribution, and the prohibition on releases. Notification must occur by labelling or inserting specific text (as described in the rule) in the Safety Data Sheet (SDS) provided with the PIP (3:1) or with any PIP (3:1)-containing product. The purpose of this requirement is to ensure that downstream users are aware of the activities that are prohibited so these products are not used in the prohibited applications or released to water.

In the accompanying Economic Analysis of the 2021 PBT EA, EPA estimated that it would require 1 hour of technical labor for each affected manufacturer, importer, and processor of PIP (3:1) and products that contain PIP (3:1) to make the necessary annotations to the SDSs. This activity is assumed to take place only in the first year of the rule. The costs were estimated at \$78.63 per firm or a total of \$2,516 (in 2018 dollars). The annualized cost for downstream notification was estimated at approximately \$136 at a 3% discount rate and \$195 at a 7% discount rate also in 2018 dollars.

Providing a 3-month transition period to update SDS’s and an 18-month transition period for updating labels under this final rule would allow more time to complete these modifications. Since downstream notification was required in the 2021 PIP (3:1) PBT rule, EPA generally assumes that firms have updated their product’s Safety Data Sheets (SDS) in the baseline. EPA acknowledges, however, that some firms may have to update the SDSs to reflect changes associated with requirements of this final rule. EPA believes that the costs of making any minor adjustments to the SDS text needed as a result of this final rule would be minimal, but since the exact number of firms modifying their SDS is unknown, incremental downstream notification costs are not quantified.

## 4.10 Total Industry Costs

Summing the costs described in Sections 4.2 through 4.7 results in the total industry costs as provided in Table 4-39 (annualized at 3% discount rate) and Table 4-40 (7% discount rate) for the final option, and Table 4-41 and Table 4-42 for the alternative option. As shown in these tables, total industry costs for the rule were estimated at approximately \$400 million (at a 3% discount rate, annualized over 30 years), and \$430 million (at a 7% discount rate). Of the rule costs, those associated with decaBDE alone were approximately \$86 at a 3% discount rate and \$128 at a 7% discount rate. Costs associated with PIP (3:1) were \$400 million and \$430 million (at 3 and 7% discount rates, respectively.)

The total industry costs associated with the alternative option were approximately \$829 million and \$821 million (at 3% and 7% discount rates, respectively). Of the alternative option costs, those associated with decaBDE were \$655 and \$656 million (at 3% and 7%) while those for PIP (3:1) were \$173 million and \$165 million (at 3% and 7% discount rates, respectively).

Total costs at a 2% discount rate are presented in Appendix A.

**Table 4-39: Total Industry Cost for the Final Option, annualized at 3% discount rate (2022\$)**

Chemical and Use	Rule Familiarization	Prohibition Costs	PPE Costs	Sign Posting	Export Notification	Total
<b>DecaBDE</b>						
Plastic Shipping Pallets	\$12	\$0	\$13	\$10	\$0	\$35
Replacement Parts for Aerospace Vehicles	\$0	\$0	\$0	\$0	\$0	\$0
Replacement Parts for Motor Vehicles	\$0	\$0	\$0	\$0	\$0	\$0
Wire and Cable Insulation	\$4	\$0	\$0	\$0	\$47	\$51
<b>All DecaBDE Uses</b>	<b>\$16</b>	<b>\$0</b>	<b>\$13</b>	<b>\$10</b>	<b>\$47</b>	<b>\$86</b>
<b>PIP (3:1)</b>						
Lubricants and Greases (except Aerospace and Turbine)	\$61	\$53,982	\$90,573	\$0	\$0	\$144,616
Lubricants & Greases (Aerospace)	\$133	\$0	\$1,037,971	\$0	\$0	\$1,038,105
New and Replacement Parts for Motor Vehicles (consumers)	\$18,412	\$871,374	\$0	\$0	\$0	\$889,786
New and Replacement Parts for Motor Vehicles (makers)	\$97,967	\$24,266,159	\$199,740,366	\$0	\$0	\$224,104,492
New and Replacement Parts for Aerospace Vehicles (consumers)	\$1,308	\$61,884	\$0	\$0	\$0	\$63,192
New and Replacement Parts for Aerospace Vehicles (makers)	\$21,633	\$3,439,494	\$22,537,309	\$0	\$0	\$25,998,436
Wire Harnesses and Electric Circuit Boards	\$21,548	\$0	\$98,059,330	\$0	\$0	\$98,080,879
Marine Antifouling Coatings	\$12	-\$506	\$1,574,260	\$0	\$0	\$1,573,766
Articles Used in Manufacturing Equipment, Semiconductor Industry, and HVACR, Power Generating, and Electronic Equipment (makers)	\$14,102	-\$1,234,256	\$49,149,065	\$0	\$0	\$47,928,912
Articles Used in Manufacturing Equipment, Semiconductor Industry, and HVACR, Power Generating, and Electronic Equipment (consumers)	\$36,610	-\$403,675	\$0	\$0	\$0	-\$367,065
Engine Filters for Locomotive and Marine Applications	\$12	\$0	\$3	\$0	\$0	\$15
Cyanoacrylate Adhesives	\$0	\$0	\$52	\$0	\$0	\$52
Aviation Hydraulic Fluid	\$61	\$0	\$457,086	\$0	\$0	\$457,147
<b>All PIP (3:1) Uses</b>	<b>\$211,859</b>	<b>\$27,054,456</b>	<b>\$372,646,017</b>	<b>\$0</b>	<b>\$0</b>	<b>\$399,912,332</b>
<b>Total</b>	<b>\$211,875</b>	<b>\$27,054,456</b>	<b>\$372,646,030</b>	<b>\$10</b>	<b>\$47</b>	<b>\$399,912,418</b>

**Table 4-40: Total Industry Cost for Final Option, annualized at 7% discount rate (2022\$)**

Chemical and Use	Rule Familiarization	Prohibition Costs	PPE Costs	Sign Posting	Export Notification	Total
<b>DecaBDE</b>						
Plastic Shipping Pallets	\$19	\$0	\$20	\$11	\$0	\$50

**Table 4-40: Total Industry Cost for Final Option, annualized at 7% discount rate (2022\$)**

Chemical and Use	Rule Familiarization	Prohibition Costs	PPE Costs	Sign Posting	Export Notification	Total
Replacement Parts for Aerospace Vehicles	\$0	\$0	\$0	\$0	\$0	\$0
Replacement Parts for Motor Vehicles	\$0	\$0	\$0	\$0	\$0	\$0
Wire and Cable Insulation	\$6	\$0	\$0	\$0	\$72	\$78
<b>All DecaBDE Uses</b>	<b>\$25</b>	<b>\$0</b>	<b>\$20</b>	<b>\$11</b>	<b>\$72</b>	<b>\$128</b>
<b>PIP (3:1)</b>						
Lubricants and Greases (except Aerospace and Turbine)	\$93	\$48,654	\$107,726	\$0	\$0	\$156,473
Lubricants & Greases (Aerospace)	\$205	\$0	\$1,038,150	\$0	\$0	\$1,038,354
New and Replacement Parts for Motor Vehicles (consumers)	\$28,287	\$1,336,715	\$0	\$0	\$0	\$1,365,002
New and Replacement Parts for Motor Vehicles (makers)	\$150,507	\$21,871,099	\$231,140,607	\$0	\$0	\$253,162,214
New and Replacement Parts for Aerospace Vehicles (consumers)	\$2,009	\$94,932	\$0	\$0	\$0	\$96,941
New and Replacement Parts for Aerospace Vehicles (makers)	\$33,235	\$1,751,015	\$22,550,348	\$0	\$0	\$24,334,599
Wire Harnesses and Electric Circuit Boards	\$33,105	\$0	\$98,070,581	\$0	\$0	\$98,103,686
Marine Antifouling Coatings	\$19	-\$1,653	\$2,249,418	\$0	\$0	\$2,247,784
Articles Used in Manufacturing Equipment, Semiconductor Industry, and HVACR, Power Generating, and Electronic Equipment (makers)	\$21,665	-\$3,702,287	\$53,902,364	\$0	\$0	\$50,221,742
Articles Used in Manufacturing Equipment, Semiconductor Industry, and HVACR, Power Generating, and Electronic Equipment (consumers)	\$56,244	-\$1,210,867	\$0	\$0	\$0	-\$1,154,623
Engine Filters for Locomotive and Marine Applications	\$19	\$0	\$5	\$0	\$0	\$23
Cyanoacrylate Adhesives	\$0	\$0	\$82	\$0	\$0	\$82
Aviation Hydraulic Fluid	\$93	\$0	\$457,164	\$0	\$0	\$457,257
<b>All PIP (3:1) Uses</b>	<b>\$325,480</b>	<b>\$20,187,608</b>	<b>\$409,516,445</b>	<b>\$0</b>	<b>\$0</b>	<b>\$430,029,534</b>
<b>Total</b>	<b>\$325,505</b>	<b>\$20,187,608</b>	<b>\$409,516,465</b>	<b>\$11</b>	<b>\$72</b>	<b>\$430,029,661</b>

**Table 4-41: Total Industry Cost for Primary Alternative Option, annualized at 3% discount rate (2022\$)**

Chemical and Use	Rule Familiarization	Prohibition Costs	PPE Costs	Labeling	Export Notification	Total
<b>DecaBDE</b>						
Other DecaBDE-containing Plastic	\$107,684	\$0	\$654,844,921	\$400,288	\$0	\$655,352,894
<b>All DecaBDE Uses</b>	<b>\$107,684</b>	<b>\$0</b>	<b>\$654,844,921</b>	<b>\$400,288</b>	<b>\$0</b>	<b>\$655,352,894</b>
<b>PIP (3:1)</b>						
Lubricants and Greases (except Aerospace and Turbine)	\$61	\$72,558	\$35,033	\$0	\$0	\$107,652
Lubricants & Greases (Aerospace)	\$133	\$40,310	\$1,090,094	\$0	\$0	\$1,130,537
Wire Harnesses and Electric Circuit Boards	\$25,141	-\$4,048,015	\$98,516,640	\$0	\$0	\$94,493,767
Articles Used in Manufacturing Equipment, Semiconductor Industry, and HVACR, Power Generating, and Electronic Equipment (makers)	\$17,695	-\$2,849,108	\$81,120,446	\$0	\$0	\$78,289,033
Articles Used in Manufacturing Equipment, Semiconductor Industry, and HVACR, Power Generating, and Electronic Equipment (consumers)	\$42,340	-\$858,861	\$0	\$0	\$0	-\$816,521
<b>All PIP (3:1) Uses</b>	<b>\$85,370</b>	<b>-\$7,643,116</b>	<b>\$180,762,214</b>	<b>\$0</b>	<b>\$0</b>	<b>\$173,204,467</b>
<b>Total</b>	<b>\$193,054</b>	<b>-\$7,643,116</b>	<b>\$835,607,135</b>	<b>\$400,288</b>	<b>\$0</b>	<b>\$828,557,361</b>

**Table 4-42: Total Industry Cost for Primary Alternative Option, annualized at 7% discount rate (2022\$)**

Chemical and Use	Rule Familiarization	Prohibition Costs	PPE Costs	Labeling	Export Notification	Total
<b>DecaBDE</b>						
Other DecaBDE-containing Plastic	\$165,436	\$0	\$654,895,281	\$614,967	\$0	\$655,675,684
<b>All DecaBDE Uses</b>	<b>\$165,436</b>	<b>\$0</b>	<b>\$654,895,281</b>	<b>\$614,967</b>	<b>\$0</b>	<b>\$655,675,684</b>
<b>PIP (3:1)</b>						
Lubricants and Greases (except Aerospace and Turbine)	\$93	\$95,706	\$48,401	\$0	\$0	\$144,200
Lubricants & Greases (Aerospace)	\$205	\$53,170	\$1,090,311	\$0	\$0	\$1,143,686
Wire Harnesses and Electric Circuit Boards	\$38,625	-\$10,470,681	\$98,528,672	\$0	\$0	\$88,096,616
Articles Used in Manufacturing Equipment, Semiconductor Industry, and HVACR, Power Generating, and Electronic Equipment (makers)	\$27,185	-\$7,369,564	\$85,098,573	\$0	\$0	\$77,756,193
Articles Used in Manufacturing Equipment, Semiconductor Industry, and HVACR, Power Generating, and Electronic Equipment (consumers)	\$65,047	-\$2,221,549	\$0	\$0	\$0	-\$2,156,501
<b>All PIP (3:1) Uses</b>	<b>\$131,155</b>	<b>-\$19,912,918</b>	<b>\$184,765,958</b>	<b>\$0</b>	<b>\$0</b>	<b>\$164,984,194</b>
<b>TOTAL</b>	<b>\$296,591</b>	<b>-\$19,912,918</b>	<b>\$839,661,239</b>	<b>\$614,967</b>	<b>\$0</b>	<b>\$820,659,879</b>

## **4.11 EPA Implementation Costs**

For the economic analyses for the 2021 final rules (U.S. Environmental Protection Agency (EPA) 2021a) and (U.S. Environmental Protection Agency (EPA) 2021b). EPA estimated that it would need one full time employee (FTE) for implementation (e.g., compliance assistance and enforcement) activities under both the decaBDE and PIP (3:1) rules (two FTEs total). This rule modifies the existing rules. EPA does not expect that it will require any additional (incremental) Agency staff time to implement the rules under these revisions (final or primary alternative options). Therefore, the total EPA implementation cost of the rule is zero. Note that TSCA implementation cannot be delegated to states.

## 5. Benefits

This section qualitatively describes the benefits of reducing the exposure to decaBDE and PIP (3:1). This includes describing specific human and environmental health effects associated with these chemicals. Knowledge of the health effects of these chemicals is crucial to understanding the benefits of reducing exposure potential.

By definition PBT chemicals, such as decaBDE and PIP (3:1), are of particular concern to human and environmental health; they do not readily degrade in the environment, accumulate at higher levels of the food chain, and are toxic to humans and other forms of life. Once released to the environment, PBT chemicals can remain in environmental media for a long time, thereby posing risks to health for extended periods (U.S. Environmental Protection Agency (EPA) 2014a).

DecaBDE and PIP (3:1) were both identified in the 2014 update of the *TSCA Work Plan for Chemical Assessments* (U.S. Environmental Protection Agency (EPA) 2014c). In the TSCA 2014 Work Plan, EPA (U.S. Environmental Protection Agency (EPA) 2014c) used a two-step process to identify chemicals for further assessment. The first step was a search of variety of sources for chemicals that met predetermined criteria, one of which was identification as a PBT chemical. In the second step, EPA (U.S. Environmental Protection Agency (EPA) 2014c) analyzed data to assign a score ranging from 3 (high) to 1 (low) to each chemical on hazard, exposure and potential for persistence/bioaccumulation. Hazard scores were assigned using the classification criteria developed by the EPA's Design for the Environment program. They combine information on the human health and environmental endpoints associated with a chemical; the highest score for any single endpoint (e.g., neurotoxicity, acute aquatic toxicity) was taken as the overall hazard score. Exposure scores were assigned by taking into account information on a chemical's uses, exposures, and releases to the environment. Persistence and bioaccumulation scores were evaluated using measured or modeled data on half-lives and bioconcentration factors, respectively. Table 5-1 provides an overview of the conclusions on decaBDE and PIP (3:1) from the TSCA 2014 Work Plan.

**Table 5-1: Summary of Data for DecaBDE and PIP (3:1) EPA's TSCA 2014 Work Plan Assessment**

Chemical	Persistence Rating	Bioaccumulation Rating	Exposure Rating	Exposure Criteria Met	Hazard Rating	Hazard Criteria Met
DecaBDE	3	3	3	Has been widely used in textiles, plastics and polyurethane foam as flame retardants. Used in products for consumer commercial, and industrial use; and building and construction materials	3	Developmental toxicity, Aquatic toxicity
PIP (3:1)	3	3	3	Widely used as a flame retardant	3	Neurotoxicity, Aquatic toxicity

**Note:** 3 = High, 2 = Moderate, 1 = Low.

**Source:** EPA (U.S. Environmental Protection Agency (EPA) 2014c)

During the screening process for developing the TSCA 2014 Work Plan chemical list, EPA identified PIP (3:1) as a neurotoxicant and aquatic toxicant with high persistence and high potential for bioaccumulation. It is important to reiterate that PIP (3:1) does not contain one single chemical, but rather

exists as a mixture of as many as fifty unspecified isomers; amounts and types of isomers in PIP (3:1) vary by the commercial formulation in question (Biomonitoring California 2012).

The economic analyses of chemical regulations often include a quantitative analysis of reductions in exposures. These analyses are based on a risk evaluation.<sup>31</sup> However, as discussed in the first section of Chapter 1, TSCA section 6(h) did not require a risk evaluation for chemicals identified as PBT. Because EPA did not conduct risk evaluations for decaBDE and PIP (3:1), it is not possible to perform a quantitative analysis in this economic analysis of the benefits of reduced exposures resulting from the rulemaking. Therefore, this chapter presents a qualitative analysis of the health effects literature for decaBDE and PIP (3:1), with the understanding that by reducing the exposure through this rulemaking, adverse health effects will be reduced.

In terms of the potential exposure reductions resulting from the rule, EPA estimates that 405,495 workers under the final option and 298,855 workers under the alternative option will benefit from reduced inhalation exposure from wearing respirators. In addition, 209,332 workers under the final option and 63,499 workers under the alternative option will benefit from wearing the required dermal protection. These values differ due to the different baseline compliance rates for respiratory and dermal PPE use. EPA also estimates that approximately 25,019 products under the final option and 14,057 products under the alternative option will be reformulated without decaBDE or PIP (3:1). This will also reduce exposure from use of decaBDE or PIP (3:1) products.

Another consideration in evaluating the net benefit of a rulemaking is the choice of chemical substitute for decaBDE or PIP (3:1), if needed. Chemicals are primarily in products because they serve a specific function or purpose in the end product. If a chemical is banned from that use to protect public health and the environment, a substitute chemical or process modification may be needed so the product performs as well as before. The chemical substitute ultimately selected will depend on a number of factors such as inherent hazard, cost, performance, availability, and various other properties (e.g., thermal, aesthetic) in the final product. Therefore, available toxicity information on previously identified possible substitutes for decaBDE and PIP (3:1) is also summarized in this section, to reflect possible effects associated with certain example substitutes. The amount of information available on the toxicity of substitutes varies widely: for some substitutes, hazard designations are based on measured data, whereas for others they are based on modeling or professional judgment. This analysis is for comparative purposes, as these substitute chemicals may not be appropriate for the uses regulated under this rule.

Because a risk evaluation was not performed, substitute chemicals or process modifications for decaBDE or PIP (3:1) have not been assessed in a comprehensive way when compared to previous economic analyses. For this chemical, substitutes were assessed by EPA (U.S. Environmental Protection Agency (EPA) 2019b) using a similar methodology as in the TSCA 2014 Work Plan (U.S. Environmental Protection Agency (EPA) 2014c). Under this methodology, EPA substitutes a rating ranging from 1 (low) to 3 (high) for persistence, bioaccumulation, environmental hazard, human health hazard, and final hazard (U.S. Environmental Protection Agency (EPA) 2019b). Ratings were developed based on measured data and information from authoritative sources and, when needed, data estimated by modeling software. It should be noted that separate ratings for human health and environmental hazard for the PBT chemical

<sup>31</sup> Quantitative analysis of exposure reductions begin with an exposure assessment that estimates exposures to the chemicals(s) in question both before and after the final regulation. The next step is a critical examination of the literature on health effects associated with the chemical(s) in question. Dose-response relationships are then developed using this health effects information, allowing changes in exposure to be linked to changes in specific health effects. Lastly, these changes in health effects are monetized using data such as medical expenditures or, for fatal outcomes, the value of a statistical life.

cannot be inferred based on the hazard rating from the TSCA 2014 Work Plan assessment (EPA 2014c). This is because the hazard rating represents the highest rating for any single human health or environmental endpoint, but the endpoint on which the hazard rating is based is not specified. However, the hazard ratings for the PBT chemical from the TSCA 2014 Work Plan assessment (U.S. Environmental Protection Agency (EPA) 2014c) are directly comparable to the final hazard ratings for the substitutes from EPA (U.S. Environmental Protection Agency (EPA) 2019b).

It is important to note that, due to data limitations, it is not possible to link exposures to specific uses of decaBDE or PIP (3:1). Instead, general exposure considerations and potential health effects (cancer, non-cancer and environmental) are described for each chemical. The majority of the information on general exposure considerations and potential health effects is culled from the U.S. EPA (2020b) Exposure and Use Assessment of Five PBT Chemicals, the U.S. EPA Environmental and Human Health Hazards of Five PBT chemicals and other government documents located summarizing hazard information.

## 5.1 Benefits of Reduced Exposure to DecaBDE

### 5.1.1 Exposure Considerations

Under this action, workers that may come into contact with decaBDE associated with several uses are required to use worker protection methods (wearing N95 masks and chemical-resistant gloves).

DecaBDE is released into air, water and soil as a result of industrial processes and product use (U.S. Environmental Protection Agency (EPA) 2017f). It was formerly widely used as a flame retardant for many consumer products, plastics and textiles for household use. However, it has been banned at the state level or voluntarily phased out of many uses due to concerns over potential health risks. Currently, it can only be used in the manufacture of wires, aerospace and motor vehicle parts, and is found in recycled plastic products. Despite reductions in use, decaBDE is expected to be found throughout the environment due to its persistence. DecaBDE has the ability to partition to soils and is thus persistent in this medium (U.S. Environmental Protection Agency (EPA) 2014a). When released to air, decaBDE is expected to partition to water or soil rather than to air (U.S. Environmental Protection Agency (EPA) 2020b). In water, it is expected to adsorb to sediments and suspended particles. Hydrolysis is not expected to occur (U.S. Environmental Protection Agency (EPA) 2014a). DecaBDE is also not expected to degrade rapidly under aerobic conditions, though slow debromination may occur under anaerobic conditions (U.S. Environmental Protection Agency (EPA) 2014a). In indoor settings, it is expected to partition to dust after direct transfer from solid articles (U.S. Environmental Protection Agency (EPA) 2020b). DecaBDE has a high potential for bioaccumulation (U.S. Environmental Protection Agency (EPA) 2020b).

DecaBDE has been observed in a variety of environmental media. As expected based on its physical properties, decaBDE has been measured at the highest concentrations in indoor dust, soil and sediment (U.S. Environmental Protection Agency (EPA) 2020b). In a systematic review of international studies on decaBDE in indoor dust, Bramwell et al. (2016) found median concentrations between 106 and 2,574 ng/g and a maximum concentration of 310,000 ng/g. DecaBDE has also been observed at detectable levels in fish, terrestrial mammals, and aquatic mammals (U.S. Environmental Protection Agency (EPA) 2020b).

Individuals in the general population may be exposed to decaBDE via air and airborne dust, direct skin contact with contaminated dust or by ingestion of contaminated food or drinking water. In an exposure assessment of decaBDE, EPA (U.S. Environmental Protection Agency (EPA) 2010a) found that the dominant exposure pathways for adults and children were dust ingestion and dermal contact with dust. DecaBDE can also be transferred through the placenta and in breastmilk; infants were exposed primarily

through breastmilk (EPA 2010a). In adults, EPA (U.S. Environmental Protection Agency (EPA) 2010a) estimated daily exposure to decaBDE of  $1.4 \times 10^2$  ng/day. Due to differences in behavior (e.g., increased hand-to-mouth activity), infants and children are expected to have higher exposures than adults. Other potential human exposure pathways include occupational exposures and release from consumer products such as upholstered furniture, textiles and electronic equipment (U.S. Environmental Protection Agency (EPA) 2020b). Furthermore, direct releases to water and indirect releases to water (deposition from air) from industrial facilities lead to elevated uptake and concentrations in edible fish species. Individuals who consume these fish (recreational fishers) may have increased internal dose of decaBDE (U.S. Environmental Protection Agency (EPA) 2020b). Biomonitoring studies in humans have found detectable levels of decaBDE in 66% of blood samples and 86% of other biomarkers, indicating that exposure to decaBDE is common (U.S. Environmental Protection Agency (EPA) 2018b).

EPA did not perform a systematic review of the literature to characterize the hazards of the PBT chemicals, and instead performed a limited survey of the reasonably available scientific information.

### **5.1.2 Health Effects Associated with the Potential for Exposure to DecaBDE**

It should be noted that separate ratings for human health and environmental hazard for decaBDE cannot be inferred based on the hazard rating from the TSCA 2014 Work Plan assessment (U.S. Environmental Protection Agency (EPA) 2014c). This is because the hazard rating represents the highest rating for any single human health or environmental endpoint, but the endpoint the hazard rating is based on is not specified. However, the hazard ratings for the PBT chemicals from the TSCA 2014 Work Plan assessment (U.S. Environmental Protection Agency (EPA) 2014c) are directly comparable to the final hazard ratings for the substitutes from EPA (U.S. Environmental Protection Agency (EPA) 2019b).

It should also be noted that most of the available studies on the hazards of decaBDE are based on commercial products containing decaBDE, which consist primarily of decaBDE (77% to 98%) but may also contain congeners such as nonaBDE and octaBDE.

#### **Cancer**

In its alternatives assessment for decaBDE, EPA classified the chemical as moderately carcinogenic<sup>32</sup> based on a National Toxicology Program (NTP) study from 1986 that found evidence of an association between decaBDE and liver cancer and benign liver tumors in rats and mice (U.S. Environmental Protection Agency (EPA) 2014a). EPA also previously concluded that there is suggestive evidence for the carcinogenic potential of decaBDE based on this same study (U.S. Environmental Protection Agency (EPA) 2008c). No epidemiologic studies have evaluated the carcinogenic potential of decaBDE. IARC determined that decaBDE is not classifiable as to its carcinogenicity in humans based on a lack of data (International Agency for Research on Cancer (IARC) 1999).

In the NTP (National Toxicology Program (NTP) 1986) study, male rats were dosed with 0, 1,120 or 2,240 mg/kg bw/day decaBDE and female rats were dosed with 0, 1,200 or 2,550 mg/kg/day through their diets for 24 months. As stated by EPA, “statistically significant increases in the incidence of neoplastic nodules in the liver were observed at both treatment doses in males and at the high dose in females, providing some evidence of carcinogenicity of decaBDE” (U.S. Environmental Protection Agency (EPA) 2008a).<sup>33</sup> In addition to liver cancer, the study also found that decaBDE exposure in male

<sup>32</sup> Defined as limited or marginal evidence of carcinogenicity in animals and inadequate evidence in humans (U.S. EPA 2011).

<sup>33</sup> At the time the NTP study was conducted, the term “neoplastic nodules” was used to describe abnormal cellular masses in rat livers. Today, some would likely be classified as benign adenomas or other preneoplastic lesions. This assumes that the

rats was associated with thyroid gland follicular hyperplasia, which is considered a precursor to thyroid tumors. NTP (National Toxicology Program (NTP) 1986) also dosed male mice with 0, 3,200 or 6,650 mg/kg bw/day and female mice with 0, 3,760, 7,780 mg/kg-day for 24 months. The combined incidence of hepatocellular adenomas or carcinomas in male mice significantly increased at low dose and increased marginally at high dose (U.S. Environmental Protection Agency (EPA) 2008a).

Based on results of the NTP (National Toxicology Program (NTP) 1986) study, EPA derived oral slope factors<sup>34</sup> for decaBDE of  $7.0 \times 10^{-4}$  per mg/kg-day and  $4.0 \times 10^{-4}$  per mg/kg-day for the endpoints of hepatic neoplastic nodules in male and female rats, respectively (U.S. Environmental Protection Agency (EPA) 2008c). That is, daily exposure to an oral dose of 1 mg/kg of decaBDE across a lifetime is associated with an upper bound estimate of increased cancer risk between 0.04% and 0.07% (400-in-a-million and 700-in-a-million) above the baseline cancer risk. The full list of cancer slope factors derived by EPA (U.S. Environmental Protection Agency (EPA) 2008a) can be found in Table 5-2 below.

**Table 5-2: Cancer Slope Factors Based on Neoplastic Effects in Chronic Rat and Mouse Studies**

Endpoint	Species	Cancer Slope Factor (mg/kg-day) <sup>-1</sup>
Neoplastic nodules in the liver	Male rat	0.0007
Neoplastic nodules or carcinomas (combined) in the liver	Male rat	0.0007
Neoplastic nodules in the liver	Female rat	0.0004
Neoplastic nodules or carcinomas (combined) in the liver	Female rat	0.0005
Follicular cell hyperplasia in the thyroid	Male mouse	0.0005
Adenomas or carcinomas (combined) in the liver	Male mouse	0.0005

Source: EPA (U.S. Environmental Protection Agency (EPA) 2008a)

### Non-Cancer

Exposures to decaBDE have been associated with a number of adverse health effects in animal studies including hepatic, renal, immune, and reproductive toxicity, along with several effects on development including neurotoxicity. In the IRIS assessment of decaBDE, developmental neurotoxicity was identified as the critical effect associated with exposure (U.S. Environmental Protection Agency (EPA) 2008b). Studies in mice have shown that decaBDE exposure during development is linked to a range of adverse neurological effects, including impairments in learning (Rice et al. 2009) and decreased strength and reflexes (Rice et al. 2007). There is limited evidence to suggest that the neurological system continues to be a target of decaBDE exposure in adulthood: one study demonstrated a decrease in brain weight following 28-days of oral gavage in rats (van der Ven et al. 2006).

Hepatic and renal effects have been observed following exposures to decaBDE at different life stages. NTP (National Toxicology Program (NTP) 1986) conducted a chronic dietary study in rats and found evidence of degeneration and thrombosis in the liver. Fujimoto et al. (Fujimoto et al. 2011) exposed pregnant rats to decaBDE and observed liver and kidney histopathological changes in offspring.

Prenatal exposure to decaBDE has also been associated with immunotoxicity and reproductive effects. In a study of mice, Teshima et al. (Teshima et al. 2008) observed that exposure to decaBDE was linked to dose-dependent adverse effects on the immune system, including decreases in antibodies and

neoplastic nodules (i.e., a small abnormal growth of tissue) are equivalent to hepatic adenomas and is characterized as “a conservative interpretation” by EPA IRIS (EPA 2008a, p15).

<sup>34</sup> Oral slope factors provide a quantitative estimate of carcinogenic risk from oral exposure. They represent the upper bound estimate of increased cancer risk associated with lifetime exposure to a chemical via ingestion.

lymphocytes. Tseng et al. observed signs of impaired development of the male reproductive system (e.g., sperm abnormalities, decreased sperm count) in mice exposed prenatally to decaBDE. In another study of male mice, Tseng et al. noted that prenatal exposures to decaBDE were also associated with changes in thyroid hormone and hepatic enzyme activity (Tseng et al. 2008, Tseng et al. 2011). In the IRIS assessment of decaBDE, a study on developmental neurotoxicity by (Viberg et al. 2003) was used to derive a reference dose for decaBDE exposure. This found an association between decaBDE exposures and signs of neurotoxicity, including significant changes in spontaneous activity level of neonatal mice (U.S. Environmental Protection Agency (EPA) 2008a). In this study male mice were given single doses of 0, 2.22 or 20.1 mg/kg decaBDE at postnatal day (PND) 3 or 19. Mice at PND 10 received a single dose of 0, 1.34, 13.4, or 20.1 mg/kg decaBDE. Pair-wise testing in the mice treated at PND 3 demonstrated neurobehavioral impacts (e.g., differences in activity patterns for locomotion, rearing, and total activity compared with controls) at the highest dose group. Minor activity differences were seen in the lowest dose group, but these differences returned to control levels after a short period of time. No effects were seen in mice treated at PND 10 or 19. EPA concluded this implies there is a window of susceptibility for the developmental neurotoxicity of decaBDE. According to EPA, “the NOAEL in this study was 2.22 mg/kg, and the lowest-observed-adverse-effect level (LOAEL) was 20.1 mg/kg for significant changes in spontaneous motor behavior and decreased habituation capability for locomotion, rearing, and total activity, worsening with increasing age” (U.S. Environmental Protection Agency (EPA) 2008a). Based on these findings, the reference dose in IRIS was set at 7 µg/kg-day. That is, oral exposures to decaBDE at daily doses up to 7 µg/kg-day are not expected to result in adverse non-cancer health effects over the course of a lifetime.

### **Environmental Toxicity**

Research indicates that decaBDE is acutely toxic to fish and aquatic invertebrates. Nakari and Huhtala (Nakari and Huhtala 2010) found that exposure to a commercial mixture of decaBDE was associated with a 96-hour LOEC of 0.0125 mg/L for hatching in zebrafish and a 48-hour EC<sub>50</sub> of 0.019 mg/L for immobilization in *Daphnia*. Several adverse effects have also been observed following chronic exposures to decaBDE. DecaBDE exposure has been associated with impaired growth in both aquatic and terrestrial species. Chronic exposure to decaBDE in aquatic organisms has also been linked to effects such as disruption of thyroid hormone (Qin et al. 2010) and oxidative stress (Feng et al. 2013). DecaBDE appears to be less toxic to plant than animal species: a study by Walsh et al. 1987) found that it did not inhibit growth of algae.

A public commenter (The Yurok Tribe et al. 2024) noted that adverse effects from decaBDE and other polybrominated diphenyl ethers (PBDEs) that threaten the recovery prospects of Chinook salmon populations that are protected by the Endangered Species Act. The commenter added that chronic exposure to PBDE flame retardants such as decaBDE also harms steelhead, which are a primary subsistence species of the Tribal government.

### **Summary**

The information in this section does not represent an exhaustive literature review nor is it an analysis of relative importance or comparative dose-response among hazards.

The carcinogenic effects of decaBDE in humans remain unclear<sup>35</sup>, but evidence from animal studies suggests that reductions in exposure to decaBDE may lead to decreases in the incidence of liver cancer. In

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<sup>35</sup> This descriptor of the database is appropriate when the weight of evidence is suggestive of carcinogenicity and a concern for potential carcinogenic effects in humans is raised, but the data are judged not sufficient for a stronger conclusion. This descriptor covers a spectrum

addition, reductions in the exposures to decaBDE may lead to reductions in developmental neurotoxicity, as well as hepatic, renal, immune and reproductive toxicity. As noted above, EPA's hazard characterization is not definitive or comprehensive. Decreases of decaBDE in the environment may be beneficial for growth and other endpoints in fish, aquatic invertebrates, and terrestrial invertebrates.

### **5.1.3 Substitutes Considerations**

In its alternatives assessment for decaBDE, EPA (U.S. Environmental Protection Agency (EPA) 2014a) identified 29 potential chemical substitutes for decaBDE. Table 5-3 summarizes the potential health, bioaccumulation, persistence and environmental risks for each pertinent alternative from EPA's alternatives assessment for decaBDE, as well as potential uses in industry. In this section, this analysis does not include all of chemicals included in the alternatives assessment for several reasons. Firstly, several of the potential substitutes in the alternatives assessment were suitable only for uses of decaBDE that have been discontinued (e.g., for flame retardant properties in mattresses and other furniture). In addition, several of the chemicals are synergists: they are intended to enhance the flame retardant capacity of decaBDE and thereby decrease its use, but have no inherent flame retardant properties when used alone. Since the regulatory options under consideration involve a complete ban of decaBDE, synergists may no longer be used as potential substitutes for decaBDE.

As shown in the table, there are alternatives for a range of potential industry uses that have low ratings for human and environmental toxicity across all endpoints, based on the Design for the Environment ratings for health endpoints (e.g., moderate, high) in the alternatives assessment for decaBDE. These ratings are based on authoritative sources such as the UN's Globally Harmonized System for the Classification and Labeling of Chemicals and U.S. EPA programs such as EPA's IRIS assessment. For the majority of endpoints, no observed (or lowest observed) adverse effect levels are compared to pre-defined criteria to rank each chemical against one another. For other endpoints an evaluation of the presence or absence of adverse effects in the body of literature on if an endpoint (i.e., cancer or genotoxicity) is conducted to determine where the chemical ranks in comparison with the pre-determined criteria.

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of evidence associated with varying levels of concern for carcinogenicity, ranging from a positive cancer result in the only study on an agent to a single positive cancer result in an extensive database that includes negative studies in other species.

**Table 5-3: Summary of DecaBDE and Potential Chemical Substitutes Hazards and Uses**

Substance Name and CAS Number	Human Health Effects <sup>1</sup>												Aquatic Toxicity <sup>1</sup>		Persistence <sup>1</sup>	Bioaccumulation <sup>1</sup>	Potential Industry Uses
	Acute Toxicity	Carcinogenicity	Genotoxicity	Reproductive	Developmental	Neurological	Repeated Dose	Skin Sensitization	Respiratory Sensitization	Eye Irritation	Dermal Irritation	Acute	Chronic				
<b>VL</b> = Very Low hazard <b>L</b> = Low hazard <b>M</b> = Moderate hazard <b>H</b> = High hazard <b>VH</b> = Very High hazard – Endpoints in colored text ( <b>VL</b> , <b>L</b> , <b>M</b> , <b>H</b> , and <b>VH</b> ) were assigned based on empirical data. Endpoints in black italics ( <i>VL</i> , <i>L</i> , <i>M</i> , <i>H</i> , and <i>VH</i> ) were assigned using values from estimation software and professional judgment.																	
DecaBDE 1163-19-5	<b>L</b>	<b>M</b>	<b>L</b>	<b>L</b>	<b>H</b>	<i>L</i>	<b>M</b>	<b>L</b>	-	<b>L</b>	<b>L</b>	<i>L</i>	<i>L</i>	<b>VH</b>	<b>H</b>	See section 2.2 for detailed use profile	
<b>Known Direct Chemical Substitutes</b>																	
Decabromodiphenyl ethane <sup>2</sup> 84852-53-9	<b>L</b>	<b>M</b>	<b>L</b>	<b>L</b>	<b>H</b>	<i>L</i>	<b>L</b>	<b>L</b>	-	<b>VL</b>	<b>VL</b>	<i>L</i>	<i>L</i>	<b>VH</b>	<b>H</b>	Electronics; Wire and Cable; Public Buildings; Construction Materials; Automotive; Storage and Distribution; Products; Textiles; Waterborne emissions & coatings	
<b>Unconfirmed Potential Substitutes</b>																	
Aluminum diethylphosphinate 225789-38-8	<b>L</b>	<i>L</i>	<b>L</b>	<b>VL</b>	<b>M</b>	<b>M</b>	<b>M</b>	<b>L</b>	-	<b>L</b>	<b>VL</b>	<b>M</b>	<b>M</b>	<b>H</b>	<i>L</i>	Electronics; Wire and Cable; Automotive; Aviation; Textiles	
Aluminum hydroxide 21645-51-2	<b>L</b>	<i>L</i>	<b>L</b>	<i>L</i>	<b>L</b>	<b>M</b>	<b>M</b>	<b>L</b>	-	<b>VL</b>	<b>VL</b>	<b>M</b>	<b>M</b>	<b>H</b>	<i>L</i>	Electronics; Wire and Cable; Public Buildings; Construction Materials; Automotive; Aerospace; Textiles; Waterborne emissions & coatings	
Ammonium polyphosphate 68333-79-9	<b>L</b>	<i>L</i>	<i>L</i>	<i>L</i>	<i>L</i>	<i>L</i>	<i>L</i>	<i>L</i>	-	<b>VL</b>	<b>L</b>	<i>L</i>	<i>L</i>	<b>VH</b>	<i>L</i>	Electronics; Wire and Cable; Public Buildings; Construction Materials; Automotive; Aerospace; Storage and Distribution; Products; Textiles;	

**Table 5-3: Summary of DecaBDE and Potential Chemical Substitutes Hazards and Uses**

Substance Name and CAS Number	Human Health Effects <sup>1</sup>												Aquatic Toxicity <sup>1</sup>	Persistence <sup>1</sup>	Bioaccumulation <sup>1</sup>	Potential Industry Uses	
	Acute Toxicity	Carcinogenicity	Genotoxicity	Reproductive	Developmental	Neurological	Repeated Dose	Skin Sensitization	Respiratory Sensitization	Eye Irritation	Dermal Irritation	Acute	Chronic				
Bis (hexachlorocyclopentadieno) cyclooctane 13560-89-9	<b>L</b>	<b>M</b>	<b>M</b>	<b>VL</b>	<b>VL</b>	<b>L</b>	<b>M</b>	<b>L</b>	-	<b>VL</b>	<b>L</b>	<b>L</b>	<b>L</b>	<b>VH</b>	<b>H</b>	Waterborne emissions & coatings	
Bisphenol A bis-(diphenyl phosphate) 181028-79-5	<b>L</b>	<b>M</b>	<b>L</b>	<b>L</b>	<b>L</b>	<b>L</b>	<b>L</b>	<b>L</b>	-	<b>L</b>	<b>L</b>	<b>L</b>	<b>L</b>	<b>H</b>	<b>H</b>	Electronics	
Brominated Epoxy Polymer(s) <sup>3</sup> 68928-70-1	<b>L</b>	<b>L</b>	<b>L</b>	<b>L</b>	<b>L</b>	<b>L</b>	<b>L</b>	<b>L</b>	-	<b>L</b>	<b>L</b>	<b>L</b>	<b>L</b>	<b>VH</b>	<b>L</b>	Electronics; Public Buildings; Construction Materials; Automotive; Storage and Distribution Products	
Mixture of Brominated Epoxy Polymer(s) and Bromobenzyl Acrylate <sup>4</sup>	<b>L</b>	<b>L</b>	<b>L</b>	<b>L</b>	<b>L</b>	<b>L</b>	<b>L</b>	<b>L</b>	-	<b>L</b>	<b>L</b>	<b>L</b>	<b>L</b>	<b>VH</b>	<b>L</b>	Electronics; Storage and Distribution Products	
Brominated epoxy resin endcapped with tribromophenol 135229-48-0	<b>L</b>	<b>L</b>	<b>L</b>	<b>L</b>	<b>L</b>	<b>L</b>	<b>L</b>	<b>L</b>	-	<b>L</b>	<b>VL</b>	<b>L</b>	<b>L</b>	<b>VH</b>	<b>L</b>	Electronics; Public Buildings; Construction Materials; Automotive	
Brominated polyacrylate 59447-57-3	<b>L</b>	<b>L</b>	<b>L</b>	<b>L</b>	<b>L</b>	<b>L</b>	<b>L</b>	<b>L</b>	-	<b>L</b>	<b>L</b>	<b>L</b>	<b>L</b>	<b>VH</b>	<b>L</b>	Electronics; Automotive; Storage and Distribution Products	
Brominated poly(phenylether) <sup>4</sup>	<b>L</b>	<b>L</b>	<b>L</b>	<b>VL</b>	<b>M</b>	<b>L</b>	<b>L</b>	<b>L</b>	-	<b>L</b>	<b>VL</b>	<b>L</b>	<b>L</b>	<b>VH</b>	<b>H</b>	Electronics; Wire and Cable; Public Buildings; Construction Materials; Automotive; Storage and Distribution Products; Textiles; Waterborne emissions & coatings	
Brominated polystyrene <sup>3</sup>	<b>L</b>	<b>L</b>	<b>L</b>	<b>L</b>	<b>L</b>	<b>L</b>	<b>L</b>	<b>L</b>	-	<b>L</b>	<b>L</b>	<b>L</b>	<b>L</b>	<b>VH</b>	<b>L</b>	Electronics; Automotive	

**Table 5-3: Summary of DecaBDE and Potential Chemical Substitutes Hazards and Uses**

Substance Name and CAS Number	Human Health Effects <sup>1</sup>												Aquatic Toxicity <sup>1</sup>	Persistence <sup>1</sup>	Bioaccumulation <sup>1</sup>	Potential Industry Uses	
	Acute Toxicity	Carcinogenicity	Genotoxicity	Reproductive	Developmental	Neurological	Repeated Dose	Skin Sensitization	Respiratory Sensitization	Eye Irritation	Dermal Irritation	Acute	Chronic				
88497-56-7																	
Ethylene bistetrabromophthalimide 32588-76-4	<b>L</b>	<b>M</b>	<b>L</b>	<b>L</b>	<b>M</b>	<b>L</b>	<b>L</b>	<b>L</b>	-	<b>VL</b>	<b>VL</b>	<b>L</b>	<b>L</b>	<b>VH</b>	<b>H</b>	Electronics; Wire and Cable; Public Buildings; Construction Materials; Automotive; Storage and Distribution Products; Waterborne emissions & coatings	
Magnesium hydroxide 1309-42-8	<b>L</b>	<b>L</b>	<b>L</b>	<b>L</b>	<b>L</b>	<b>L</b>	<b>L</b>	<b>L</b>	-	<b>M</b>	<b>L</b>	<b>L</b>	<b>L</b>	<b>H</b>	<b>H</b>	Electronics; Wire and Cable; Public Buildings; Construction Materials; Automotive; Aerospace; Storage and Distribution Products; Waterborne emissions & coatings	
Melamine cyanurate 37640-57-6	<b>L</b>	<b>M</b>	<b>M</b>	<b>M</b>	<b>M</b>	<b>L</b>	<b>H</b>	<b>L</b>	-	<b>L</b>	<b>L</b>	<b>L</b>	<b>L</b>	<b>VH</b>	<b>L</b>	Electronics; Wire and Cable; Public Buildings; Construction Materials; Automotive; Aerospace; Textiles; Waterborne emissions & coatings	
Melamine polyphosphate 15541-60-3	<b>L</b>	<b>M</b>	<b>M</b>	<b>L</b>	<b>L</b>	<b>L</b>	<b>M</b>	<b>L</b>	-	<b>L</b>	<b>VL</b>	<b>L</b>	<b>L</b>	<b>H</b>	<b>L</b>	Electronics; Wire and Cable; Public Buildings; Construction Materials; Automotive; Aerospace; Storage and Distribution Products; Waterborne emissions & coatings	
N-alkoxy hindered amine reaction products 191680-81-6	<b>L</b>	<b>M</b>	<b>L</b>	<b>H</b>	<b>H</b>	<b>L</b>	<b>H</b>	<b>L</b>	-	<b>L</b>	<b>VL</b>	<b>H</b>	<b>H</b>	<b>H</b>	<b>H</b>	Construction Materials; Textiles	

**Table 5-3: Summary of DecaBDE and Potential Chemical Substitutes Hazards and Uses**

Substance Name and CAS Number	Human Health Effects <sup>1</sup>												Aquatic Toxicity <sup>1</sup>	Persistence <sup>1</sup>	Bioaccumulation <sup>1</sup>	Potential Industry Uses
	Acute Toxicity	Carcinogenicity	Genotoxicity	Reproductive	Developmental	Neurological	Repeated Dose	Skin Sensitization	Respiratory Sensitization	Eye Irritation	Dermal Irritation	Acute	Chronic			
Phosphonate oligomer 68664-06-2	<b>L</b>	<b>M</b>	<i>L</i>	<i>L</i>	<i>L</i>	<b>M</b>	<i>L</i>	<i>L</i>	-	<b>M</b>	<b>M</b>	<b>L</b>	<b>H</b>	<b>VH</b>	<b>H</b>	Electronics; Public Buildings; Construction Materials
Phosphoric acid, mixed esters with [1,1'-bisphenol-4,4'-diol] and phenol 1003300-73-9	<b>L</b>	<b>M</b>	<b>L</b>	<i>L</i>	<i>L</i>	<b>L</b>	<b>L</b>	<b>L</b>	-	<b>VL</b>	<b>VL</b>	<b>H</b>	<b>H</b>	<b>H</b>	<b>M</b>	Electronics; Automotive; Aerospace
Polyphosphonate 68664-06-2	<b>L</b>	<i>L</i>	<i>L</i>	<i>L</i>	<i>L</i>	<i>L</i>	<i>L</i>	<i>L</i>	-	<b>M</b>	<b>M</b>	<b>L</b>	<b>H</b>	<b>VH</b>	<b>H</b>	Electronics; Wire and Cable; Public Buildings; Construction Materials; Automotive; Aerospace; Textiles
Poly[phosphonate-cocarbonate] 77226-90-5	<b>L</b>	<i>L</i>	<i>L</i>	<i>L</i>	<i>L</i>	<i>L</i>	<i>L</i>	<i>L</i>	-	<i>L</i>	<i>L</i>	<i>L</i>	<i>L</i>	<b>VH</b>	<b>L</b>	Electronics; Wire and Cable; Public Buildings; Construction Materials; Automotive; Aerospace
Red phosphorus 7723-14-0	<b>L</b>	<i>L</i>	<b>M</b>	<i>L</i>	<i>L</i>	<i>L</i>	<i>L</i>	<b>L</b>	-	<b>M</b>	<b>M</b>	<b>L</b>	<b>L</b>	<b>H</b>	<b>L</b>	Electronics; Wire and Cable; Automotive; Aerospace; Waterborne emissions & coatings
Resorcinol bisdiphenylphosphate 125997-21-9	<b>L</b>	<b>M</b>	<b>L</b>	<b>L</b>	<b>M</b>	<b>M</b>	<b>M</b>	<i>L</i>	-	<b>L</b>	<b>VL</b>	<b>VH</b>	<b>VH</b>	<b>M</b>	<b>H</b>	Electronics
Substituted amine phosphate mixture <sup>4</sup>	<b>H</b>	<b>M</b>	<b>M</b>	<b>M</b>	<b>M</b>	<i>L</i>	<b>M</b>	<b>L</b>	<b>M</b>	<b>M</b>	<b>VL</b>	<b>M</b>	<i>L</i>	<b>H</b>	<b>L</b>	Electronics; Wire and Cable; Public Buildings; Construction Materials; Automotive; Aerospace; Storage and Distribution Products

**Table 5-3: Summary of DecaBDE and Potential Chemical Substitutes Hazards and Uses**

Substance Name and CAS Number	Human Health Effects <sup>1</sup>												Aquatic Toxicity <sup>1</sup>	Persistence <sup>1</sup>	Bioaccumulation <sup>1</sup>	Potential Industry Uses
	Acute Toxicity	Carcinogenicity	Genotoxicity	Reproductive	Developmental	Neurological	Repeated Dose	Skin Sensitization	Respiratory Sensitization	Eye Irritation	Dermal Irritation	Acute	Chronic			
Tetrabromobisphenol A bis (2,3-dibromopropyl ether) <sup>3</sup> 21850-44-2	L	M	M	M	M	L	M	L	-	L	L	L	L	VH	H	Electronics; Public Buildings; Construction Materials; Automotive
Triphenyl phosphate 115-86-6	L	M	L	L	L	L	H	L	-	L	VL	VH	VH	L	M	Electronics
Tris(tribromoneopentyl) phosphate <sup>3</sup> 19186-97-1	M	M	L	M	M	H	L	L	-	L	L	L	L	H	M	Electronics; Public Buildings; Construction Materials; Textiles
Tris(tribromophenoxy) triazine <sup>3</sup> 25713-60-4	L	L	L	L	L	L	L	L	-	L	VL	L	L	VH	H	Electronics

**Notes:**

<sup>1</sup> Hazard classifications (e.g., high, moderate) are based on the Design for the Environment (DfE) criteria for alternatives assessment.

<sup>2</sup> Decabromodiphenyl ethane (DBDPE) is structurally very similar to decaBDE and is known to already have substituted decaBDE in some products and uses, though it may not be an appropriate substitute for all potential uses listed.

<sup>3</sup> Based on structure, chemical is considered a likely potential substitute for decaBDE.

<sup>4</sup> CAS number for potential alternative is confidential.

**Sources:**

ILEPA (2007); EPA (2014a)

#### **5.1.4 Effects of Final Regulatory Action and Primary Alternative**

Under EPA's final regulatory action, inhalation and dermal PPE are required during the recycling process of pallets containing decaBDE, and during the manufacturing and processing of decaBDE and decaBDE-containing replacement parts for use in aerospace or motor vehicles. Additionally, all persons who process, including recycle, decaBDE-containing plastic shipping pallets must place signs at every entry point into the regulated area, and releases of decaBDE to water is prohibited during the manufacture, processing, or distribution in commerce. Individuals who may be occupationally exposed in the sectors that use decaBDE under these regulated conditions will experience reduced exposures as a result of the final action. Where the compliance date for prohibition has been extended (i.e., for processing and distribution in commerce of decaBDE for use in wire and cable insulation in nuclear power generation facilities) the benefits of the regulation will be delayed.

The alternative option would further reduce aggregate exposure to decaBDE by including the requirement for inhalation and dermal PPE during all recycling processes of plastics and requiring a label on all recycled plastic articles containing decaBDE. Individuals who may be occupationally exposed in the sectors that use decaBDE under these additional regulated conditions would experience further reduced exposures as a result of the alternative option.

## **5.2 Benefits of Reduced Exposure to PIP (3:1)**

### **5.2.1 Exposure Considerations**

Under the final action, certain uses of PIP (3:1) will be phased out over the next 30 years and worker personal protective equipment (masks/respirators and gloves) are required during the manufacturing and processing of PIP (3:1) in uses that are not prohibited. For the processing of PIP (3:1) in the manufacturing of cyanoacrylate adhesives, other industry best practices for engineering controls and exhaust ventilation are also required.

PIP (3:1) is used for a variety of industrial purposes: it is a component of many products and formulations, and is also used as a manufacturing aid (U.S. Environmental Protection Agency (EPA) 2020b). It has been found in products ranging from hydraulic fluid for airplanes to plastic children's toys (U.S. Environmental Protection Agency (EPA) 2020b). Releases to air, land, and water from manufacture, processing, distribution and use of PIP (3:1) are possible (EPA 2020b). When released to air, a fraction of PIP (3:1) is expected to partition to soil or water, based on its Henry's Law constant (EPA 2020b). PIP (3:1) remaining in air is either decomposed by reaction with hydroxyl radicals, or removed via wet and dry deposition (NLM 2015b).

In soil, PIP (3:1) is expected to adsorb to organic matter and to have limited mobility (EPA 2020b). PIP (3:1) in water is also expected to adsorb to suspended soils and sediments (NLM 2015a). Due to its low solubility, low vapor pressure, and ability to adsorb to organic particles, volatilization is not expected after release to water or soil (NLM 2015b). Although there are no available studies on its biodegradation potential, studies of similar chemicals suggest that PIP (3:1) is not easily biodegradable (NLM 2015b).

In the indoor environment, PIP (3:1) is expected to be found primarily in dust rather than air (EPA 2020b). Exposure to PIP (3:1) can occur through inhalation or ingestion (EPA 2020b). Environmental monitoring data on PIP (3:1) are limited; however, since triphenyl phosphate is often found in the same commercial formulations as PIP (3:1), environmental monitoring studies of this chemical can also provide insight into expected patterns of PIP (3:1) (EPA 2020b). PIP (3:1) has been identified in ambient air, water, soil and sediment (EPA 2020b). Although no studies of PIP (3:1) in

indoor air and dust have been identified to date, the presence of PIP (3:1) is also expected in these media based on studies of triphenyl phosphate (EPA 2020b).

Occupational exposures to PIP (3:1) may occur via dermal contact or inhalation (NLM 2015b). No biomonitoring studies on PIP (3:1) have been identified to date, but several studies have detected triphenyl phosphate in human biomonitoring samples (Cequier et al. 2015; Fromme et al. 2014; Henriquez-Hernandez et al. 2017). Based on evidence from biomonitoring studies of triphenyl phosphate, children are expected to have higher average daily doses to PIP (3:1) than adults (EPA 2020b).

EPA did not perform a systematic review of the literature to characterize the hazards of the PBT chemicals, and instead performed a limited survey of the reasonably available scientific information.

## **5.2.2 Health Effects Associated with Exposure**

### **Cancer**

PIP (3:1) has not been classified by the International Agency on Cancer Research, and does not have a carcinogenicity assessment in EPA's IRIS. Laboratory studies on the carcinogenicity of PIP (3:1) are not available (NLM 2015b). However, in one longitudinal cohort study of 850 exposed workers, no significant increases in cancer risk or mortality were observed (NLM 2015b).

### **Non-Cancer**

PIP (3:1) is toxic to aquatic plants, aquatic invertebrates, sediment invertebrates, and fish. In vitro and animal studies indicate it may be toxic to humans. The specific adverse health effects will depend on the formulation of PIP (3:1) under consideration. In OECD guideline studies submitted by manufacturers and summarized by the European Chemicals Agency (ECHA) in the REACH Registration Dossier, PIP (3:1) exposure in rats has been associated with a number of adverse effects on reproduction and development, including reduced fertility, reduced litter sizes, damage to ovaries and increased ovary weights (ECHA 2023). These studies also show changes and increases in other organ and gland weights, such as the liver, thyroid, and adrenals (ECHA 2023). Additionally, "decreased serum albumin/globulin ratio, increased relative liver weights, and decreased serum albumin concentration, decreased creatine levels, decreased terminal body weights, and increased absolute liver weights" were seen in rats exposed once daily for four days (Auerbach et al. 2022). Additionally, neurological effects have been observed in laboratory animals, but this evidence is mixed. Studies of subacute and subchronic exposures in hens have found indicators of neurotoxicity such as ataxia (loss of control of body movements), neurological lesions, and degeneration of the spinal cord (NLM 2015b). There is one case report of neurotoxic effects of PIP (3:1) in one exposed worker, finding decreases in number of nerve potentials and in nerve conduction velocities. In an inhalation study in rabbits, PIP (3:1) exposure proved to be lethal at high doses (ECHA 2018). One surveillance study in multiple workers did not observe increased morbidity or mortality when comparing rates in the workers to morbidity and mortality rates in what they describe as the comparable segment of the U.S. population (NLM 2015b).

### **Environmental Toxicity**

The aquatic toxicity of PIP (3:1) is dependent on the exact composition of the substance. According to ECHA (2018), if PIP (3:1) is composed of greater than 5% triphenyl phosphate, it is expected to be an aquatic toxicant. Acute lethality after exposure to PIP (3:1) has been observed in various species of fish, with 96-hour LC<sub>50</sub>s ranging from 1.6 to over 1,000 mg/L depending on the species and composition of PIP (3:1) (EPA 2020b). Acute exposures to PIP (3:1) in minnows have also been associated with increases in hemorrhages and abnormal behavior, while chronic exposures significantly decrease survival rates and growth (ECHA 2017). In a chronic study of exposure to aquatic invertebrates, decreased growth

and reproductive capabilities were observed (ECHA 2017). Adverse effects on growth have also been observed in algae (ECHA 2017). Limited information is available on the terrestrial toxicity of PIP (3:1), but reductions in growth and impaired reproduction have been observed in earthworms (EPA 2020b).

### **Summary**

The information in this section does not represent an exhaustive literature review, nor is it an analysis of relative importance or comparative dose-response among hazards.

There are currently no data to suggest that PIP (3:1) is a carcinogen; no cancer-related benefits are expected as a result of decreases in exposure. However, reductions in the exposures to PIP (3:1) may lead to reductions in the potential for noncancer health concerns. Depending on the composition of PIP (3:1), decreases in exposure may increase survival rates, growth and reproductive capabilities in aquatic and terrestrial organisms.

### **5.2.3 Substitutes Considerations**

This section presents information on the toxicity of substitutes for PIP (3:1). Two of the substitutes – 2-ethylhexyl diphenyl phosphate ester and isodecyl diphenyl phosphate – have the same final hazard rating as PIP (3:1), though persistence and bioaccumulation are expected to be lower. On the other hand, the triaryl phosphates isobutylenated (Phenol, isobutylenated, phosphate (3:1)) substitute is rated as less hazardous than PIP (3:1) but has the same ratings as PIP (3:1) for persistence and bioaccumulation.

Assuming that the exposures to the substitutes are equivalent to the exposures to PIP (3:1), to the extent that this regulation results in use of substitutes, EPA anticipates that hazards and exposures will be at most equivalent (if not less) than the hazards and exposures in the absence of this regulation.

**Table 5-4. Persistence, Bioaccumulation and Hazard Ratings for Potential Chemical Substitutes Hazards and Uses for PIP (3:1)**

Substance Name	CAS Number	Persistence Rating	Bioaccumulation Rating	Environmental Hazard Rating	Human Health Hazard Rating	Final Hazard Rating
2-ethylhexyl diphenyl phosphate ester	1241-94-7	1	1	3	2	3
Triaryl Phosphates isobutylenated (Phenol, isobutylenated, phosphate (3:1))	68937-40-6	3	3	1	2	2
Isodecyl diphenyl phosphate	29761-21-5	1	1	3	2	3
<b>Note(s):</b> 3 = High, 2 = Moderate, 1 = Low. Unknown (U) indicates that EpiSuite and ECOSAR (v2.0) could not be used to predict the chemical's persistence and bioaccumulative properties and environmental hazard, respectively.						
The Persistence, Bioaccumulation and Hazard Ratings for PIP (3:1) are presented in Table 5-1.						
<b>Source(s):</b> EPA (2014c, 2019b)						

#### 5.2.4 Effects of Final Action and Primary Alternative

Under the final regulatory action, prohibitions on the processing and distribution for various uses of PIP (3:1) will be phased in: non-turbine/non-aerospace uses of lubricants and greases (5-year phase-in), new/replacement motor vehicle parts (15-year phase-in with additional 15 years for distribution), aerospace (30-year phase-in), and articles in manufacturing equipment and semiconductors (10-year phase-in). Additionally, worker personal protective equipment (masks/respirators and gloves) is required during the manufacturing and processing of PIP (3:1) in uses that are not prohibited. Individuals who may be occupationally exposed in the sectors that use PIP (3:1) under these regulated conditions will experience reduced exposures as a result of the final action. Where the compliance date for prohibition has been extended (i.e., for use of PIP (3:1) in FIFRA approved marine antifouling coatings) the benefits of the regulation will be delayed.

Under the primary alternative option, EPA would prohibit PIP (3:1) in all lubricants and greases (5-year phase-in) and in articles in manufacturing equipment and semiconductors (20-year phase-in). To the extent that prohibition is delayed under the primary alternative option, benefits would be reduced. However, exposure would be mitigated to the extent that personal protective equipment is required until the use is prohibited.

### 5.3 Conclusion on Benefits of Regulating DecaBDE and PIP (3:1)

Exposure to decaBDE or PIP (3:1) to the workers and the environment is likely under the conditions of use regulated under the final action. In this section, a summary of the health and environmental effects of the chemicals is presented, along with a discussion of how the final regulatory option reduces exposures and risks. Since decaBDE and PIP (3:1) are persistent in the environment, it is important to note that, though exposure is expected to decrease as a result of the regulatory action, it is not expected to immediately cease after the 30-year prohibition phase-in period. It should also be noted that data on the effects of exposure to these chemicals are still lacking for many endpoints; additional health and environmental hazards may be associated with the chemical. On the other hand, since data on the potential alternatives are not always complete in many cases, it is often also not possible to fully characterize the degree of risk associated with exposures to any substitute chemicals.<sup>36</sup>

DecaBDE is a potential human carcinogen that is persistent and bioaccumulative. DecaBDE is additionally associated with developmental neurotoxicity, hepatic toxicity, and several other adverse non-cancer health effects in humans, as well as with toxicity in aquatic organisms. The final regulation requires PPE to reduce exposures to the occupationally exposed population, thereby reducing the aforementioned adverse effects of decaBDE. The primary alternative option would provide additional protection for workers recycling all decaBDE-containing plastic, but less protection for workers manufacturing and processing of decaBDE and decaBDE-containing replacement parts for use in aerospace or motor vehicles. Since there are numerous potential substitutes for decaBDE – some of which may pose greater or equal risk than decaBDE – substitute chemicals should be carefully selected to realize benefits to human health and the environment.

PIP (3:1) is toxic to aquatic plants, aquatic invertebrates, sediment invertebrates, and fish. Data indicate the potential for reproductive and developmental effects, neurological effects and effects on systemic organs. In addition, PIP (3:1) has high persistence and high potential for bioaccumulation. It is prohibited under the final regulatory option, with the exception of uses in aviation hydraulic fluid, turbine and

<sup>36</sup> In general, regulatory analysis is strengthened by considering how alternatives potentially impact human health and the environment.

aerospace lubricants and greases, cyanoacrylate adhesives, certain specialty engine filters, articles made from recycled materials, and for wire harnessing and electric circuit boards. Personal protective equipment is required for uses that are not prohibited. Therefore, the potential for occupational exposures to PIP (3:1) is either reduced or eliminated, depending on the industry in question. Under the primary alternative option, certain phase-in timeframes would be extended, so benefits would decrease compared to the final option to the extent that the reduction in exposures lessens. Since several of the potential alternatives identified posed a comparable hazard to human and environmental health to PIP (3:1), the choice of alternatives will inform and affect benefits of the rule.

Further research would help characterize the full set of health hazards and environmental concerns associated with decaBDE and PIP (3:1). Since the chemicals are persistent and bioaccumulative, they are expected to remain in the environment for long periods of time; preventing the potential for initial releases to air, land and water through manufacture and/or use of these chemicals protects human health and the environment. The final action is expected to reduce the exposures to decaBDE and PIP (3:1) and thus have benefits for human health and the environment. Careful selection of substitutes for the chemical will help ensure that these benefits are realized.

## **Understanding the Costs Associated with Eliminating Exemptions for Articles in SNURs**

November 20, 2014

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Office of Pollution Prevention and Toxics

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## **Notice**

This document was prepared to provide economic information for the rulemaking process. Due to the nature of the information available to EPA, the document contains various assumptions that may not reflect the regulatory determinations that an individual firm or organization would make were it to apply the rule's requirements to its specific circumstances. This is not an official guidance document and should not be relied upon to determine applicable regulatory requirements. Mention of the names of specific companies, organizations, entities, goods, or services does not constitute an endorsement by EPA.

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## Contributors

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## 1 Introduction

Under the Toxic Substances Control Act (TSCA), there are a variety of methods available to the U.S. EPA to gather information and limit the use of toxic chemicals. One such method is the promulgation of Significant New Use Rules (SNURs) at 40 CFR part 721. A SNUR requires that manufacturers (including importers) and processors of the subject substances notify EPA at least 90 days before beginning any activity that EPA has designated as a “significant new use.” In general, the use designations are potential new uses that could result in new or increased exposures to, or releases of, the substance. The notification required by SNURs, known as a Significant New Use Notification (SNUN), allows EPA the opportunity to review and, if necessary, prevent or limit potentially adverse exposure to, or effects from, the new use of the substance.

In most cases, SNURs have applied to the manufacture or processing of chemical substances but have, under 40 CFR § 721.45(f), exempted importers and processors of articles containing the chemical substance. Although TSCA does not specifically define “article,” the Act does refer specifically to articles in several provisions and provides EPA the authority to regulate chemical substances contained in articles. “Article” is defined in several regulations promulgated under TSCA’s authority, including 40 CFR §§ 704.3, 710.3(d), and 720.3(c). Given the increasing evidence that toxic substances are released from articles during use and at the end of their useful life (Massey et al., 2008), a number of recent proposed SNURs, such as those for benzidine-based chemicals, polybrominated diphenyl ethers (PBDEs), hexabromocyclododecane (HBCD), and perfluorinated compounds (PFCs) and other final SNURs related to mercury and erionite fiber, have included provisions to eliminate the exemption for persons that import or process the chemical substances as part of articles.

With the exemption at 40 CFR § 721.45(f) made inapplicable, SNUN submission requirements are also triggered for persons that import or process the chemical substance as part of an article. The term “article” is defined by EPA in the context of requirements under TSCA for the reporting of new chemical substances by manufacturers at 40 CFR § 720.3(c): “*Article* means a manufactured item (1) which is formed to a specific shape or design during manufacture, (2) which has end use function(s) dependent in whole or in part upon its shape or design during end use, and (3) which has either no change of chemical composition during its end use or only those changes of composition which have no commercial purpose separate from that of the article and that may occur as described in § 720.36(g)(5), except that fluids and particles are not considered articles regardless of shape or design.” (SNURs are codified at 40 CFR part 721, which does not include its own specific definition for “article.”) Articles can range from simple single-component products, such as fabric, to highly complex multi-component products such as an automobile.

The costs of submitting a SNUN is addressed in the economic analyses for the individual rules, and EPA does not believe these costs will vary between manufacturers or processors of these chemical substances, as part of articles or otherwise. Importers of articles retain broad latitude to determine what, if any, inquiry is necessary to determine whether their future imports may contain a subject chemical substance. This paper explores some of the compliance assurance measures these entities may employ. The responsibilities of processors of articles under SNUR requirements are also discussed in this paper, along with the likely compliance assurance measures that correspond with their limited level of liability.

### 1.1 Importers

Under TSCA, the definition of “manufacture” means to “import..., produce or manufacture.” Importers have varying levels of knowledge about the chemical content of the articles they import, yet based on this definition, they are responsible parties under the regulation. In order to understand and monitor their liability, companies might undertake a range of activities to ensure that the articles they import do not violate existing regulations. This paper identifies some of the resources and tools that are available to importers in developing and implementing their procedure to identify any chemicals subject to SNURs in their imported articles. The paper further describes the range of activities that businesses are likely to

undertake based on various characteristics including their experience with similar requirements for chemicals regulated under other authorities, the complexity of their supply chain, and the size of the company. Potential cost ranges are then estimated for importing companies based on these characteristics, to the extent possible.

## **1.2 Processors**

The term “process” is defined by TSCA § 3(10) as, “the preparation of a chemical substance or mixture, after its manufacture, for distribution in commerce -- (A) in the same form or physical state as, or in a different form or physical state from, that in which it was received by the person so preparing such substance or mixture, or (B) as part of an article containing the chemical substance or mixture.” There are a number of ways in which a company may become a processor of a chemical substance as part of an article. For example, a processor of a chemical substance in an article might be someone who receives an article and assembles it into another product for a specific use. SNUR reporting requirements for persons who intend to manufacture or process a subject chemical substance are described in § 40 CFR 721.5; however, the reporting requirements for processors do not apply in some circumstances. As described in § 40 CFR 721.5(c), a processor is not required to submit a SNUR if he can document that (1) he does not know the specific chemical identity of the chemical substance being processed; and (2) that he is processing the chemical substance without knowledge that the substance is subject to a SNUR. This paper focuses on the standard business practices that EPA believes a processor would already undertake that may document what is known about the chemicals being processed as part of articles.

## **2 Regulatory Background**

### **2.1 Selected Foreign Regulations**

A number of nations worldwide place restrictions on the manufacture and use of hazardous chemicals. This section highlights a selection of key regulations imposed by other nations that require the identification of hazardous chemicals. To the extent that importers and processors of articles who are subject to SNURs are already subject to any of these regulations, for example because of business they conduct in other countries, they may have already instituted policies and procedures that would mitigate the cost of evaluating whether regulated chemicals are a part of articles they manage.

#### **2.1.1 REACH - European Union**

The European Union’s (EU) legislation addressing the safe use of chemicals, Regulation (EC) No 1907/2006, known as *Registration, Evaluation, Authorisation and Restriction of Chemicals* (REACH), came into effect in 2007. It applies to all chemicals imported or produced in the EU. Manufacturers and importers are required to collect information on the properties of their chemicals and to submit the information to a central database administered by the European Chemical Agency (ECHA) in Helsinki, Finland (European Commission Directorate-General for the Environment (EC DG Environment), 2012a).

Under REACH, an article is “an object which during production is given a special shape, surface or design which determines its function to a greater degree than its chemical composition” (ECHA, 2011a). Article producers, importers, and suppliers are subject to various registration, notification, and communication requirements. Generally, article producers and importers must register any substances intended to be released from articles if the amount present in an article totals more than one tonne per year and the substance is not already registered for that use. Article producers and importers must also provide notification about any “substances of very high concern” in articles if the amount present in an article totals more than one tonne per year and when the concentration of the substance in the article is more than 0.1 percent. Article suppliers are subject to communication of information requirements for all articles containing substances of very high concern, if the concentration of the substance in the article is more than 0.1 percent, regardless of the total amount (ECHA, 2011b).

## 2.1.2 REACH-like Regulations in Other Countries

A number of other nations have adopted legislation similar to or based on the European Union's REACH. For example, China's regulation, Provisions on the Environmental Administration of New Chemical Substances in China came into effect in 2010 and applies mainly to chemicals and mixtures of chemicals. It places obligations on manufacturers of substances in China and importers of substances into China. It includes requirements for new chemicals that are released from articles during normal use, consistent with EU REACH's requirement that intentionally released chemicals (in quantities greater than one tonne) must be registered (Electronics Weekly Blogs, 2010).

Additional nations continue to develop and implement regulations. For example, South Korea's proposed Act on Registration and Evaluation of Chemicals ("K-REACH") has been submitted to its National Assembly and is expected to come into force in 2015. Under the Act, the manufacturers or importers of new chemicals and priority evaluation chemicals must submit registration prior to manufacture and import (He, 2012).

Other countries are also requiring stricter oversight of their imports. New Zealand's law associated with the management of hazardous substances is the Hazardous Substances and New Organisms Act 1996 (HSNO Act). Under the HSNO Act, no hazardous substances can be imported or manufactured except in accordance with the Act or with an approval issued by the NZ Environmental Protection Authority (NZ EPA) under the Act. The Act applies to items falling under its definition for 'substance,' and delegates the authority to NZ EPA to develop regulations under the Act to define what is considered a "hazardous substance." The initial responsibility for determining what substances are classified as hazardous substances under the HSNO Act rests with the importer or manufacturer of the substance. When a company applies to the NZ EPA to import or manufacture a hazardous substance, a classification of each hazardous property of the substance is determined. These hazard classifications trigger a set of regulatory controls developed for the level of hazard. The HSNO generally does not apply to articles, except those with explosive properties: manufactured articles with explosive properties (such as flares or detonators) are considered substances under the HSNO Act. Manufactured articles, even if they contain or incorporate hazardous substances with properties other than explosiveness, are not considered to be substances (NZ EPA, 2012). NZ EPA provides guidance to assist in determining whether an item is a manufactured article. An article must meet all of these criteria: (1) the item was deliberately formed to a specific shape or design during manufacture, (2) the item has an end use function wholly or partly dependent on its shape or design, (3) the item undergoes no change of chemical composition during end use, except as an intrinsic part of that end use, and (4) the item is not a particle or fluid (NZ EPA, 2011). Although articles (other than explosives) would not be subject to the HSNO Act's Controls for hazardous substances, articles containing a hazardous substance can be regulated under "group standards" set according to Part 6A of the HSNO Act. A group standard provides requirements for a set of hazardous substances that have a similar nature, are of a similar type, or have similar circumstances of use, so that the risks of the grouped hazardous substances can be effectively managed by one set of conditions (NZ Parliamentary Counsel Office, 2012).

Malaysia's Environmentally Hazardous Substances Notification and Registration Scheme includes a notification requirement for hazardous substances manufactured in or imported to Malaysia (Malaysia Department of Environment, Hazardous Substances Division, 2012a). The requirements apply to manufacturers and importers of environmentally hazardous substances (EHS) and importers of chemical mixtures or finished products (e.g., articles) that contain EHS as their constituents (Malaysia Department of Environment, Hazardous Substances Division, 2012b).

Norway's proposed *Prohibition on Certain Hazardous Substances in Consumer Products (PoHS)* would ban four hazardous substances (lead, pentachlorophenol (PCP), perfluorooctyl acid (PFOA), and medium-chained chlorinated paraffins (MCCP)) in nearly all consumer products above certain concentration limits

(Bureau Veritas Group, 2012). It applies to both imported products as well as products produced in Norway (Norwegian Pollution Control Authority, 2010). The ban was scheduled to take effect in 2012.

### **2.1.3 RoHS - European Union**

The European Union's legislation *Restriction of Hazardous Substances Directive* (RoHS) took effect in 2006 and limits the use of certain hazardous substances in specific types of articles: electrical and electronic equipment (EC DG Environment, 2012b). RoHS restricts the use of the following six substances: lead (Pb), mercury (Hg), cadmium (Cd), hexavalent chromium (Cr<sup>6+</sup>), polybrominated biphenyls (PBB), and polybrominated diphenyl ether (PBDE) in several categories of electrical and electronic equipment including household appliances, information technology (IT), and consumer equipment. RoHS allows a maximum concentration of 0.1 percent by weight in homogenous materials for lead, mercury, hexavalent chromium, PBB, and PBDE and 0.01 percent by weight in homogenous materials for cadmium. "Homogeneous material" means a material that cannot be mechanically disjointed into different materials.

In 2011, a revised version of RoHS (RoHS2) took effect which provides for a gradual extension of the requirements to all electrical and electronic equipment (EEE) (European Parliament, 2011). European member countries were required to adopt RoHS2 by transposing the regulation into their national laws by January 2, 2013 (EC DG Environment, 2012c).

RoHS places specific requirements on importers. Under RoHS2, importers may sell only compliant EEE on the European Union market. Before placing EEE on the market, an importer must ensure that the appropriate conformity assessment procedure has been carried out by the manufacturer, and ensure that the manufacturer has drawn up the technical documentation, that the EEE bears the required marking and is accompanied by the required documents (European Parliament, 2011).

### **2.1.4 RoHS-like Regulations in Other Countries**

Several nations have adopted regulations similar to or based on the EU's RoHS. For example, the People's Republic of China enacted the *Administrative Measure on the Control of Pollution Caused by Electronic Information Products*, or "China RoHS," as it is commonly called, in 2006. China's regulation focuses on the same six substances as the EU RoHS and requirements are similar. However, China's regulation applies to all "electronic information products" which are listed on the Ministry of Information Industry of the People's Republic of China (MII) website (IPC, 2009). An unofficial English translation of this list was produced by American Electronics Association (2006).

South Korea's *Act for Recycling of Electrical and Electronic Equipment and Automobiles*, known as "Korea RoHS," came into effect in 2008. Korea RoHS applies to the following EEE: televisions, refrigerators, mobile telephone terminals (including batteries and chargers), washers (limited to those for household use only), personal computers (including monitors and keyboards), audio equipment, air-conditioners, printers (including ink cartridges and toner cartridges), copiers (including ink cartridges and toner cartridges), fax machines (including ink cartridges and toner cartridges); and the following types of vehicles: passenger cars, vans, and trucks less than 3.5 tons. It applies to the same six substances as the EU RoHS, with the same concentration limits in homogeneous materials, but the PBB and PBDE restrictions do not apply to vehicles (ERA Technology Ltd., 2008).

Japan's Law for Promotion of Effective Utilization of Resources incorporates the Japanese Industrial Standard JIS C 0950, titled *The Marking for Presence of the Specific Chemical Substances for Electrical and Electronic Equipment* (MOSS). The law applies to the manufacturers and importers of the following products: personal computers, unit-type air conditioners, television sets, refrigerators, washing machines, clothes dryers, microwaves. It applies to the same six substances as the EU RoHS, and requires that the products listed above be marked to indicate the presence of the substances (Japan Electronics and Information Technology Industries, 2008).

## **2.2 Selected Relevant U.S. Regulations (Federal and State)**

U.S. importing and processing companies may already be familiar with the process of determining whether they are importing or processing particular restricted chemical substances as part of articles, if they are subject to U.S. regulations such as the following.

### **2.2.1 CPSIA**

The *Consumer Product Safety Improvement Act* (CPSIA) of 2008 authorized regulations and testing requirements for children's products and some non-children's products. The Act limits the amount of lead allowed in surface coatings or paint on any consumer product designed or intended primarily for children 12 years of age or younger to 90 ppm and reduces the amount of total lead content in children's products to 100 ppm, unless not technically feasible. The Act also makes it unlawful for any person to manufacture for sale, distribute in commerce, or import any children's toy or childcare article that contains the phthalates di-2-ethylhexyl phthalate (DEHP), dibutyl phthalate (DBP), or benzylbutylphthalate (BBP) at levels higher than 0.1 percent (U.S. Consumer Product Safety Commission (CPSC), 2008a). An interim ban has also been placed on the phthalates diisononyl phthalate (DINP), diisodecyl phthalate (DIDP), and di-n-octyl phthalate (DnOP) at levels higher than 0.1 percent in toys that can be placed in a child's mouth and in child care articles (U.S. CPSC, 2008b). More information on total lead content in children's products under CPSIA can be found on the U.S CPSC's Total Lead Content website (U.S. CPSC, 2008c). More information on phthalates regulation under CPSIA can also be found on the U.S. CPSC's Phthalates website (U.S. CPSC, 2008b).

### **2.2.2 California - Proposition 65**

California's Proposition 65 (Prop 65) restricts the use of listed toxic chemicals known to cause cancer or birth defects or other reproductive harm in products sold and used in California. California Prop 65, known as the *Safe Drinking Water and Toxic Enforcement Act*, was enacted in California in 1986. The Act affects all products sold or distributed in California, including textiles, hard goods, toys, juvenile products, and electrical/electronic items. Prop 65 requires businesses to provide residents with notifications of significant amounts of chemicals in their products, in their homes or workplaces, or that are released into the environment. By providing this information, Prop 65 enables residents to make informed decisions about protecting themselves from exposure to these chemicals. This Act requires that anyone in the course of doing business who exposes an individual to a chemical "known to the State" to cause cancer or reproductive toxicity must first give a "clear and reasonable" warning. Currently, over 881 chemicals are listed by the State of California as known carcinogens or reproductive toxins (California Office of Environmental Health Hazard Assessment, 2010). The current Prop 65 list of chemicals is located at [http://oehha.ca.gov/prop65/prop65\\_list/newlist.html](http://oehha.ca.gov/prop65/prop65_list/newlist.html) (California Office of Environmental Health Hazard Assessment, 2013).

### **2.2.3 Washington - Children's Safe Product Act**

Under the *Children's Safe Product Act*, the State of Washington makes manufacturers of children's products responsible for reporting the presence of chemicals of high concern to children. The first part of the Act limited the amount of lead, cadmium and phthalates allowed in children's products sold in Washington after July 1, 2009. These standards were substantially preempted when the U.S. Congress passed the Consumer Product Safety Improvement Act (CPSIA) in July, 2008. The second part of the law mandates two state departments in Washington to develop a list of toxic chemicals that have either been found in children's products or have been documented to be present in human tissue (blood, breast milk, etc.). This list is known as the "Reporting List of Chemicals of High Concern to Children" and can be found on the Washington State Department of Ecology's website (n.d.-a). Manufacturers must report on the content of these listed chemicals in their children's products. The Act broadly defines "manufacturer" to include the producer, importer, and domestic distributor of the product. It establishes a hierarchy for

determining which entities meet the statutory definition of “manufacturer” that the department will hold primarily responsible for ensuring that reporting requirements are satisfied with respect to any children’s product (Washington State Department of Ecology, n.d.-b).

#### **2.2.4 Maine - An Act to Protect Children's Health and the Environment from Toxic Chemicals in Toys and Children's Products**

Maine’s *Act to Protect Children’s Heath and the Environment from Toxic Chemicals in Toys and Children’s Products*, as enacted in 2008, calls for the identification of chemicals of high concern as “priority chemicals” based on exposure of a child or fetus. Manufacturers or distributors of children’s products for sale in Maine must provide notification of any product containing a priority chemical (Maine Legislature, 2008). A list of chemicals found on Maine’s List of Chemicals of High Concern is available online (Maine Department of Environmental Protection, 2012). Implementation of the rule is intended to be done in collaboration with Washington State’s Department of Ecology, consistent with their Children’s Safe Product Act program (Maine Department of Environmental Protection, 2011).

#### **2.2.5 Possible Future State Regulations**

According to an analysis by Safer States (a national coalition of state-based environmental health organizations), during 2013 several states introduced bills to reduce exposure to harmful chemicals (Safer States, 2013). As of June 2013, at least 28 states are considering policies to address concerns over toxic chemicals in consumer products. The bills cover a broad range of topics, including bans in consumer products and disclosure requirements. Some categories of chemicals being considered are:

- 1) **Toxic Flame Retardants:** At least 15 state legislatures are considering policies to phase out the use of toxic flame retardants, including Tris (1,3-dichloro-2-propyl) phosphate (chlorinated Tris) in consumer products such as children’s products, home furniture, and building insulation. Chlorinated Tris is found in products made of foam and is considered a carcinogen under California’s Proposition 65 (California Office of Environmental Health Hazard Assessment, 2013). States that are considering restrictions on flame retardants include California, Connecticut, Delaware, Illinois, Maine, Massachusetts, Maryland, Missouri, New Jersey, Nevada, North Carolina, New York, Oregon, Vermont, and Washington.
- 2) **Bisphenol A:** At least 16 states are considering policy to restrict or label the use of the endocrine-disrupting chemical Bisphenol A (BPA) in items such as baby food jars, infant formula and other, food/beverage packaging, children’s products, and plastic containers. States that have introduced such bills include Arizona, Connecticut, Hawaii, Kentucky, Massachusetts, Maine, Minnesota, Nevada, New Jersey, New York, North Carolina, Pennsylvania, South Dakota, Tennessee, Texas, and West Virginia.
- 3) **Chemicals Harmful to Children:** At least 10 states, including Alaska, Connecticut, Delaware, Florida, Maine, Massachusetts, Minnesota, New York, Oregon, and Vermont, will consider additional bills to identify chemicals of concern for children’s health and/or require makers of consumer products to disclose their use of the chemicals. Many of these bills include provisions to encourage manufacturers to identify and use safer alternatives in their products.

Links to the bills introduced in each state can be found on Safer States’ website (Safer States, 2013).

### **3 Regulated Entities**

Without the exemption at 40 CFR 721.45(f) applicability to importers and processors of the subject chemical substances as part of articles to the SNUR provisions is expanded. Once such a SNUR becomes effective, importers and processors of articles may take steps to ensure that they do not import or process the regulated chemicals as part of an article in a manner that would constitute a significant new use as described by the SNUR. Given the scope of the term “article” (under 40 CFR part 720, an item formed to a specific shape or design during manufacture, which has end use function(s) dependent in whole or in part upon its shape or design during end use), the applicability of SNURs potentially increases

significantly. A report prepared for the European Commission/ Directorate-General Enterprise on costs of regulating chemicals as part of articles under REACH estimates that there are between 500,000 and 5 million imported article types that are subject to REACH, falling under approximately 5,300 product categories (Risk and Policy Analysts Limited (RPA), 2003).

An estimation of the specific number of product sectors is challenging, because applicability of each SNUR to a type of industry would depend on the specific chemicals covered by the SNUR, and their known uses.

The Nordic Council of Ministers 2010 report *REACH Trigger for Information on Substances of Very High Concern (SVHC)* provides an understanding of the types of product groups known to be of concern regarding content of toxic chemicals (which can provide some insight into product types that may be the subject of a SNUR). In order to present a broad picture of the realities in different product sectors, case studies were selected by the report authors. The selection was performed by identifying product groups containing articles meeting the following criteria:

- Known presence of SVHC in the article
- Variety and complexity of the articles
- Relevant share of production within EU and of import into the EU-market
- Different possible exposure pathways from the SVHC contained (human health, environment)

The initial case study pre-selection led to the following product groups:

- 1) Cars and parts of cars, e.g. seats, tires
- 2) Electronics
- 3) Computers
- 4) White goods
- 5) Furniture
- 6) Home trainer [home exercise equipment]
- 7) Roofing felt
- 8) Shoes
- 9) Textiles
- 10) Tools
- 11) Toys
- 12) Windows

Additionally, the United Nations Environment Programme's (UNEP's) *A Synthesis of Findings Under the UNEP/IOMC Project on Information on Chemicals in Products* identified product sectors of "highest priority" for focus related to stakeholder information needs on chemicals in products (UNEP/DTIE Chemicals Branch, 2011). Product sectors of highest priority were: 1) children's products/toys, 2) electronics, 3) clothing, and 4) construction materials.

The applicability of a SNUR to importers or processors within a particular industry is dependent on the specific chemical substance(s) covered by the SNUR, and can include a wide variety of sectors with a large number of entities. For any SNUR without the article exemption, the subject article importers or processors of chemicals in articles could fall into one or many industry sectors; a number of diverse article importers or processors could potentially be affected. To develop a robust estimate of the number of entities given readily available information would not likely be possible given the uncertainties involved.

#### **4 Identifying Substances Subject to a SNUR in Articles**

Under a SNUR with no exemption for persons that import or process the chemical substance(s) as part of articles, importers may determine whether the articles they import are likely to contain the regulated chemical substance, and if so, comply with the notification requirements of the SNUR (notify EPA at

least 90 days before commencing the import of any articles containing chemicals subject to the rule). Processors may be unlikely to undertake additional activities specifically to identify subject chemical substances in the articles they process given the standard applied to processors in §721.5(c), described in Section 1.2. Rather, processors would demonstrate compliance through their existing documentation, as described in Section 4.2. To the extent that processors desire extra certainty that the articles they process are not subject to a SNUR, they may undertake the steps in the process outlined below for importers.

RPA (2003) identified general methods for obtaining information on substances in articles: literature review; written questionnaires/telephone contact; and chemical analysis. Thus, making the determination of whether an article contains a substance subject to a SNUR may involve using existing information about the product and/or chemicals; gathering information from suppliers; and/or testing samples of the article itself. The industry consensus standard ASTM F2577 *Standard Guide for Assessment of Materials and Products for Declarable Substances* provides some guidance in developing a process for the determination.

Given the existing regulatory limitations on certain chemicals both internationally and within the United States (as described in Section 2), regulated industries have begun to develop industry-wide processes and other resources to support such a determination. Massey et al. (2008) describe information systems that have been developed on a voluntary basis. These systems for managing the chemicals in their supply chain fall into four categories:

- 1) Restricted and preferred substance lists: Suppliers sign agreements certifying that specified products do not contain restricted substances. (e.g., American Apparel & Footwear Association (AAFA) Restricted Substances List)
- 2) Surveys/questionnaires: Importers require suppliers to complete forms providing information on chemicals contained in components (e.g., Joint Industry Guide for Material Composition Declaration for Electronics Products (JIG));
- 3) Databases: Importers direct suppliers to report the use of specific (or all) chemicals used in their products to a database (e.g., Global Data Synchronization Network (GDSN), International Material Data System (IMDS), BOMcheck);
- 4) Third-party certifications/labeling (e.g., Bluesign® standard, Green Seal).

Based on the ASTM industry standard, and the strategies listed above, Section 4.1 provides a generalized list of the activities that a company may take to identify a substance subject to a SNUR in articles. Section 4.3 describes in more detail some of the available tools and methods for companies to collect data from their suppliers. Section 4.4 provides examples of organizations that are further providing services or guidance to assist importers in managing the chemicals in their supply chain.

#### **4.1 Typical Components of Process (Importers)**

The elimination of the exemption at 40 CFR 721.45(f) for importers and processors of chemicals as part of articles would require notification to EPA before the importation of articles containing the regulated chemical substance(s) for a significant new use. Because the rule would not prescribe the steps that an importer must take to identify a chemical subject to a SNUR in articles, there are a variety of specific actions that a company could take to identify specific substances in its articles. EPA expects that in all likelihood, importers would take actions that are commensurate with the perceived likelihood that the regulated chemical is part of the article they intend to import, and the resources it has available.

ASTM's *Standard Guide for Assessment of Materials and Products for Declarable Substances* ("ASTM F2577") provides guidance for the decision process to assess materials and products for declarable substances. ASTM International, formerly known as the American Society for Testing and Materials (ASTM), is recognized worldwide for the development of international voluntary consensus standards. Developed in response to regulations restricting materials used in finished goods, such as REACH and

RoHS, ASTM F2577 seeks to provide a consistent method to comply with these and other similar regulations (ASTM International, 2012).

ASTM F2577 provides a general description of the process of assessing materials and/or products for the content of declarable (or restricted) substances. It relies on two means for this assessment: both *a priori* and *a posteriori* knowledge. Therefore, determinations can be made based on information gleaned through logical deduction and scientific principles (*a priori* knowledge), as well as on observation, experience and known facts (*a posteriori* knowledge) including laboratory tests to verify or generate information on the concentration of a chemical substance.

The following list of activities that an importer might perform to identify specific chemicals in imported articles was developed based in part on ASTM F2577 and on example processes described in industry guidance, such as AFIRM (2011). This list is intended to capture the general types of activities performed. Whether or not an individual importing company undertakes each specific listed activity, and the extent to which each is performed, likely depends on a number of factors that are outlined in Section 5.

- 1) **Understand applicable requirements.** The importer would read and understand the SNUR, within the context of the company's products. As noted in ASTM F2577-06, "The first step in any assessment is to determine what is covered by requirements, or the scope of the requirements." *Frequency:* this would be a one-time activity for the importing company.
- 2) **Identify the types of imported articles that potentially contain the chemical(s) subject to a SNUR.** A list of the kinds of articles that the company imports that have the potential to contain the chemical(s) subject to a SNUR can be developed based on an understanding of the uses of the subject substance; broad use categories for SNUR-regulated chemicals are often known, e.g., used in textile dyes, laundry detergents, consumer electronics, etc. Imported articles that fall into highly regulated categories, such as building products, furniture glues, textiles, etc., are candidates for particular scrutiny. ASTM F2577-06 says to "apply *a priori* knowledge [based upon scientific principles and logical deduction] of the material and its manufacture to assess the probability whether each [regulated] substance may be present." The level of effort called for here may depend on the complexity of the imported article itself; an airplane, for example, has many components to consider.

*Frequency:* an initial review of the company's imports would be a one-time activity; however, a company may do a similar review on each potential new product imported to determine whether it likely contains restricted chemical substances.

- 3) **Identify all suppliers involved.** Importers may identify the suppliers from whom the articles identified in the previous step are imported, and as necessary, make them aware of the SNUR on the regulated chemical.

*Frequency:* an initial identification of suppliers would be a one-time activity; however, an importer may assess each new supplier.

- 4) **Collect data from suppliers.** Importers may obtain verification from suppliers that the regulated chemical substance is or is not found in the article. This may be accomplished through any of the strategies described in the introduction to Section 4 above – for example, agreements with suppliers, declarations through databases or surveys, or by using a third-party certification system.

*Frequency:* initial data collection from suppliers would be a one-time activity, and any additional data collection a company undertakes as new products are considered for import and suppliers change would add to the cost. A company may also make periodic confirmations with suppliers reporting any changes in the article's content or manufacturing process.

5) **Chemical testing.** Importers may assess imported articles for chemical content. This could involve requiring suppliers to provide certificates of analysis/laboratory reports for a lot or batch of the material produced. Importers could perform their own laboratory testing of articles (or components of articles) to determine if they contain a substance subject to a SNUR. This could be done, as suggested in ASTM F2577-06, as “good practice to periodically confirm material data.” Testing may also be done where there is no other information available.

*Frequency:* as needed. The amount of testing performed would depend on the number of articles and suppliers, and would vary as new products are considered for import and suppliers change.

6) **Recordkeeping.** It is expected that the importer may keep records confirming the activities completed. This activity is recommended by ASTM F2577-06, in the following statement, “Document the assessment process for each material or product. Documentation in the form of data and illustration of the assessment process is necessary to back up statements of compliance for materials and products.” *Frequency:* as necessary.

## **4.2 Compliance Assurance for Article Processors**

There are a number of ways in which a company can be a processor of chemical substances in an article. A company that assembles a product out of various supplied parts (articles) could be a processor of the chemical components of those parts. For example, a processor could be a company making blankets out of fabric, or a company manufacturing furniture out of treated wood. Under § 40 CFR 721.5(a)(2), manufacturers or processors of subject chemical substances who distribute the substance in commerce must notify the recipient, in writing, of the applicability of SNUR requirements, or document that the recipient has such knowledge or will not undertake any significant new use described in the rule.

Therefore, as the recipient of any subject chemical substance, the processor of a subject chemical as part of an article should receive written notification from the supplier, and would presumably keep this documentation as part of their standard business practice along with other documentation such as Material Safety Data Sheets, shipping or labeling documents, etc. that may provide information on the chemicals in the articles they process. Review of this documentation and flagging any chemicals subject to a SNUR or any other requirement are believed to be standard business practice. If a processor desires still greater certainty that it is in compliance with a SNUR (above and beyond being able to document, after-the-fact, that any processing of the subject substance was without knowledge), it may undertake further steps similar to those outlined in Section 4.1 (i.e., screen the articles it processes as an importer would screen the articles it imports). EPA expects that in all likelihood, the extent that any of these activities would be performed would be commensurate with the perceived likelihood that the regulated chemical is part of the article that they intend to process, and the resources it has available.

## **4.3 Example Data Collection Tools and Methods**

There is currently no single, widely accepted standard procedure to identify regulated chemicals in supply chains (Swedish Monitoring Board, 2002; RPA, 2003; Massey et al., 2008). However, there are a number of organizations that help provide information on the content of articles, organize declarations from suppliers, or certify suppliers based on materials or processes used. Furthermore, there are continued efforts by organizations, such as the International Council of Chemical Associations (ICCA) (through its Global Product Strategy), to encourage improved product stewardship with downstream customers in the chemical industry (International Council of Chemical Associations, 2013). Importers (or processors) subject to SNURs may refer to these sources for assistance in their own strategy to identify a chemical subject to a SNUR in articles. Some examples are described below. The list is not all inclusive and resources are continually being developed.

### **4.3.1 American Apparel & Footwear Association (AAFA) Restricted Substances List**

The American Apparel & Footwear Association (AAFA) Restricted Substances List (RSL) “is intended to provide apparel and footwear companies with information related to regulations and laws that restrict or

ban certain chemicals and substances in finished home textile, apparel, and footwear products around the world.” (AAFA, 2013). The RSL is a tool for the apparel and footwear industry that lists materials, chemicals, and substances that are restricted or banned in finished home textile, apparel, and footwear products because of a regulation or law; that is, it is specific to requirements for finished products, not substances used during the manufacturing process. It does not include California Proposition 65 requirements for labeling. The list is reviewed and updated every six months (AAFA, 2012a). The most recent version was published in March, 2013 (AAFA, 2013). According to Massey et al. (2008), firms are using this list to develop internal materials tracking programs to ensure that specific substances (e.g., those that are regulated, restricted, or of interest due to corporate policies) are accounted for. These companies require that suppliers sign agreements certifying that specified products do not contain substances that are of interest to the company. In addition, some agreements specify that if testing identifies a restricted material, the supplier must cover all associated costs.

The AAFA RSL is intended to be used by industry in conjunction with the Apparel and Footwear International RSL Management (AFIRM) Group’s *Supplier RSL Toolkit* industry guidance that is focused on the elimination of restricted substances from finished products. (See section 4.4.1) of this report for more information on the AFIRM toolkit.) Additionally, AAFA has developed a List of Non-Regulated Substances Contained in AFIRM RSL Guidance (AAFA, 2012b). This list was based on the work done by the AFIRM group and includes chemicals that are neither regulated nor proven to be dangerous, but may be of note to the industry.

### **4.3.2 Joint Industry Guide (JIG)**

The Japan Green Procurement Survey Standardization Initiative (JGPSSI) has been working on standardizing survey instruments for the electric and electronics sector in Japan. Such standardized survey instruments are used by companies in collecting information about the composition of chemical substances in their products. In conjunction with the Electronics Industry Alliance (EIA) and the European Information and Communication Technology Industry Association (EICTA), JGPSSI has developed the Joint Industry Guide (JIG) for Material Composition Declaration for Electronic Products. The JIG is a standardized survey used to communicate the composition of chemicals in electronic products between suppliers and customers. The survey is initiated by the customer (“requester”) with the supplier (“respondent”) asked to indicate where specific chemicals have been used in the components they supply. Since the survey form is standardized, the process of filling out the requisite information is simplified as suppliers and customers are not surprised by the request. The survey is a one to two page instrument and the chemical management system includes about 340 specific chemicals arranged into 24 groups (Japan Green Procurement Survey Standardization Initiative, 2006).

### **4.3.3 Global Data Synchronization Network (GDSN)**

The Global Data Synchronization Network (GDSN) is a customizable data management platform that enables companies to share information about their products with their trading partners. For example, Wal-Mart has created a new data management system contained within the GDSN that tracks materials present in chemical-intensive products (such as cleaning and personal care products). Wal-Mart’s system allows suppliers to submit detailed information about chemical ingredients to a third party, which in turn keeps this information confidential. Suppliers may direct the third party to grant Wal-Mart access to selected information stored in the system (Wal-Mart, 2012).

While this system was initially designed to document the ingredients of chemical-intensive products, it may be adapted to manage information on the contents of any article. The system can also store information that may be relevant for future regulations, sustainability, or purchasing initiatives. Other potential advantages of the GDSN include safer shipping, handling, storage, and disposal; increased consistency and accuracy of data; improved regulatory compliance; and cost reductions and efficiency improvements (Massey et al., 2008). Many retailers and grocery chains currently use GDSN; services do

not seem limited to particular industry sectors. Membership fees are based on a company's revenue, and are detailed in Section 5.2.4.

#### **4.3.4 International Material Data System (IMDS)**

The European Union's End-of-Life Vehicle (ELV) Directive is intended to increase recycling of materials used in vehicles and to reduce pollution associated with vehicle dismantling. This directive, as well as other factors, has made it important for auto manufacturers to track the chemicals present in the products they receive from their suppliers. To this end, they have built an online system to facilitate information exchange with suppliers. The International Material Data System (IMDS) is an online database that suppliers use to provide information on substances in the parts they sell to auto manufacturers. Suppliers register for this database and enter information on substances present in their products. In 2006, the IMDS listed more than 8,000 substances. The IMDS also contains a default list of 111 substances that are likely to be present in a vehicle at the point of sale and must be declared (Massey et al., 2008).

This system could serve as a useful model for data management in other industries. However, an auto industry representative noted that data management technology has improved since the IMDS was designed, and a newer tool could offer enhanced efficiency and functionality (Massey et al., 2008).

#### **4.3.5 BomCheck - Substances Declarations Database**

BOMcheck provides a resource for importers and product manufacturers to gather substance declarations from their suppliers. The process is initiated by a product manufacturer or importer directing their suppliers to register the use of either specific chemicals or all chemicals in the production of hardware articles and electrical and electronic equipment. If the supplier also uses other ("secondary") suppliers for providing components for the manufacture of components needed for the original manufacturer, they may direct these secondary suppliers to also register the use of these chemicals. In order to register chemicals used in the supply chain, suppliers need to be registered with BOMcheck. A Regulatory Compliance Declaration (RCD) is provided by BOMcheck after a supplier has registered their use of chemicals. The tool for the RCD includes expert regulatory guidance on all substances which are restricted or declarable for hardware products by regulations in North America, Europe and Asia Pacific (ENVIRON, 2013a).

#### **4.3.6 Bluesign® Technologies AG**

Bluesign Technologies AG is a private firm that works with suppliers within the fabrics supply chain to assure manufacturers and retailers that fabrics have been produced taking environmental protection and health and safety of workers and customers into account. Bluesign Technologies AG achieves this by providing tools to assist suppliers to exclude substances which are potentially hazardous to human health or the environment from processes at the outset through an intelligent Input Stream Management system. It is an independent standard that can be applied to the entire production chain and that delivers certainty at all levels, from raw material to final product, from chemical supplier to consumer (Bluesign Technologies AG, 2011).

Based on assessments by Bluesign Technologies AG, components, production processes and technology used in the fabrics supply chain may fall in 3 color-coded rankings: *Blue* for those that have been checked according to five Bluesign Technologies AG standard principles – these may be used for all applications under the Bluesign standard; *gray* for those that may be used under one or more pre-conditions following the principles of the best available technology; and *black* for those not to be used in fabrics. The textile product is certified only if the raw materials and technologies used meet the criteria of the Bluesign standard in a concluding assessment at the respective production plant (Bluesign Technologies AG, 2011).

#### **4.3.7 Green Seal**

Green Seal is a non-profit organization that develops "life cycle-based sustainability standards for products, services and companies and offer third-party certification for those that meet the criteria in the

standard” (Green Seal, 2012a). A product that has achieved Green Seal™ Certification has met rigorous, science-based leadership standards. For example, the Green Seal Certification Checklist for soaps, cleansers, and shower products lists prohibited components including the following: 2-butoxyethanol; alkylphenol ethoxylates; butylated hydroxytoluene; ethoxylated chemicals; ethylene diaminetetra-acetic acid or any of its salts; formaldehyde donors; heavy metals including lead, hexavalent chromium, or selenium both in the elemental form or compounds; halogenated organic solvents; methyldibromo glutaronitrile; monoethanolamine, diethanolamine, and triethanolamine alone or in compounds; nitro-musks; parabens; phthalates; and polycyclic musks (Green Seal, 2012b).

If a SNUR-regulated chemical substance is prohibited in Green Seal’s certification process, then an importing company may use a Green Seal™ Certification to help determine that an article does not contain the chemical.

#### **4.4 Other Resources**

There are a number of organizations, worldwide, that work to provide their stakeholders with guidelines and procedures to assist in identifying restricted chemicals. This section provides a brief description of examples of these types of organizations. Mention of resources is solely for illustrative purposes; it does not represent a recommendation or endorsement of the particular organization.

##### **4.4.1 Trade Association Guidance: The Apparel and Footwear International RSL Management (AFIRM) Working Group Supplier RSL Toolkit**

The Apparel and Footwear International RSL Management (AFIRM) Working Group has developed a toolkit (AFIRM, 2011) for suppliers that is meant to help reduce the use of harmful substances in the apparel and footwear supply chain. The toolkit provides information and guidelines that enable AFIRM companies to create a Restricted Substances List (RSL). An RSL is a list of chemicals and other materials that suppliers and other members of their supply chains ban from use during the manufacturing product or from finished products entirely. AFIRM suppliers are responsible for educating their vendors on their RSL requirements.

The AFIRM Supplier Toolkit (2011) sets forth guidelines, information, and suggestions for suppliers to implement their own RSL programs. These implementation steps, as outlined in the toolkit, include:

- 1) Internal Communication: Develop and publish a company policy and design an implementation plan.
- 2) Communicate to Facilities/Suppliers: Inform members of the company’s supply chain of RSL requirements and provide them with basic chemical and legislation information.
- 3) Testing and Reporting Results: Identify and communicate the company’s needs to the testing laboratories that ensure that verify RSL compliance.
- 4) Continuous Improvement Best Practices: Track changes in legislation relevant to restricted substances in apparel manufacturing and adopt new, more stringent requirements.

##### **4.4.2 Consulting Firm: Intertek**

Given the rise of regulations restricting the use and distribution of harmful chemical substances both internationally and within the U.S., various consulting firms now specialize in providing services to support companies in greening their supply chains. One such firm, Intertek, helps to ensure that their clients’ products maintain compliance throughout the entire supply chain by providing “comprehensive assessment, product testing, validation, product certification, and consulting services to assist companies [in] successfully achiev[ing] green supply chain management” (Intertek, n.d.). Specifically targeting compliance with EU RoHS, China RoHS, REACH, and California Proposition 65, the basic steps that they take, as outlined on their website, include:

- 1) Identification of applicable requirements
- 2) Compliance Assurance Process implementation and certification

- 3) Employee and vendor communication and training
- 4) Supplier data collection
- 5) Gap Analysis and Risk Assessment
- 6) Product re-engineering (if required)
- 7) Product screening and testing based upon GAP/Risk Assessment
- 8) Green claims verification/certification, product labeling, and marketing launch

Their Compliance Assurance System specifically involves an assessment of risk in the supply chain, training to perform risk-based product assessments, definition of high risk materials and/or components, a test plan for products, and how to take samples from actual products for testing.

#### **4.4.3 Joint Article Management Promotion Consortium (JAMP)**

JAMP is a cross-industry consortium that seeks to promote the “establishment and dissemination of effective and workable mechanisms to facilitate disclosure/transfer of information on chemicals contained in products across the supply chain.” The consortium was initially developed for companies in Japan, and over time they have extended their reach to other countries in eastern Asia. In response to REACH and similar regulations, JAMP recognizes that there is a need for information sharing between the upstream and downstream companies throughout a supply chain, and that an individual company or a single industry association may not be able to efficiently handle this issue on its own. JAMP is working on the following activities:

- Creation, verification, and dissemination of management guidelines for information on chemicals contained in preparations and articles
- Providing tools and operating rules to disclose the information on chemical substances. This includes the creation of the Article Information Sheet (AIS) and “AIS Creation Guidelines” – a standard document that contains characteristics of articles, similar to an MSDS
- Developing the information infrastructure to share and convey article information, based on self-declaration, and disseminating this system domestically and overseas (see: Joint Article Management Promotion-consortium, 2011).

JAMP membership is open to companies or groups who have interest in chemicals contained in products. Members are able to participate in and provide feedback on the activities described above. Annual membership fees range from about \$215 to \$2,000.<sup>1</sup>

## **5 Costs (Importers)**

Obtaining an accurate estimate of the cost of the elimination of the exemption in SNURs for imported articles is complicated by the range of activities a company may employ to determine whether their imported articles contain chemical substances subject to a SNUR. As noted above, there are a number of methods by which a company may collect data from suppliers. RPA (2003) described factors that made obtaining data on substances in articles from suppliers easier or more difficult:

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<sup>1</sup> The annual fee varies for firms of different sizes where firms with less than 100 employees pay about \$215 and firms with more than 1,000 employees pay about \$2,000.

**Table 1: Factors Affecting the Ease of Obtaining Information on Substances**

Factors Making Data-Gathering Easier	Factors Making Data-Gathering Harder
The organization requesting information is a major/important customer of the supplier	The requesting organization is not a key customer
The requesting organization has close or longstanding links with the supplier	The requesting organization switches suppliers frequently (e.g. in fashion items)
The supplier is a large, multinational company	The supplier is a small company
The supply chain is short and simple	The supply chain is long and/or complex
Products and processes remain unchanged for long periods	Product and process development is rapid, with frequent changes in substances used
There is no secrecy about product composition	The substance content of products is commercially valuable information and/or secret for other reasons

Source: Swedish Monitoring Board (2002) as cited in RPA (2003).

For the purposes of this analysis, we assume that information is available once a method of collecting it has been arranged (i.e., there is no secrecy issue or unwillingness to share). It is also assumed that companies would only reach out to their immediate suppliers of articles at first; should that supplier not have information on the chemical content, a company may move higher into the supply chain to gain the information. Therefore, the complexity of the supply chain would be a relevant factor in the cost incurred.

Variation on the method of data collection (and therefore cost) depends on a company's level of baseline activity, the complexity of the supply chains, and the size of the company. Section 5.1 describes these characteristics. Section 5.2 explains how the burden and cost is estimated, according to importer characteristics, for each of the components of the chemical identification process that was described in Section 4.1. Section 5.3 presents costs for various importer company characteristic scenarios. Last, Section 5.4 summarizes the cost findings.

This analysis acknowledges that there may be opportunity costs associated with a firm's decision to simply not import an article in order to avoid issue of determining whether the article contains the SNUR chemical. In addition, a firm may simply decide not to import a chemical known to be part of an article that is designated as a significant new use. While this decision would avoid any costs of making this determination, as discussed below, it may entail "hidden" costs of the foregone profit of not engaging in the commercial activity originally planned. These impacts are acknowledged; however, they are not quantified, since doing so requires data on firm behavior that are not available.

## 5.1 Characteristics of Importers Affecting Cost

### 5.1.1 Level of Baseline Compliance with Other Chemical Restriction Requirements

Section 2 of this report described existing international and U.S. regulations that restrict the use of chemicals in articles. As a result of these regulations, we expect some article importers to already have a process in place to communicate with suppliers of products and manage the chemical content of their articles. In particular, importers in certain business sectors or geographic locations would be more likely to be affected by these existing regulations.

For the purpose of this analysis, we assume article importers fall into two main groups:

- *Otherwise-regulated:* Article importers to U.S. states that restrict the use or otherwise regulate substances in articles (e.g., California's Proposition 65), of products that are regulated at the U.S. federal level (e.g., children's toys and cribs), or that import into or deal with suppliers from countries that restrict or otherwise regulate the use of substances in articles (e.g., countries subject to REACH, RoHS, etc.) would already be in compliance with these regulations and thus, already incur the associated costs. Importers in certain sectors, like electronics, automotive, or textiles,

would be expected to fall into this category because their products are highly regulated by international regulations and traded worldwide.

- *Not otherwise-regulated:* Articles importers in this category do not have any experience with (or current costs associated with) regulations or restrictions on chemicals in articles or dealing with suppliers operating under article regulations.

“Otherwise-regulated” importers are expected to have some processes in place for managing some chemicals in their supply chain. With a SNUR that eliminates the article exemption, these importers are likely to modify their processes to include managing the chemical in question. For each new SNUR promulgated, this would involve additional actions specific to each chemical and associated articles subject to the SNUR, and to the associated suppliers; marginal increases in costs are expected.

“Not otherwise-regulated” importers, on the other hand, would likely put a new process in place for managing the chemical subject to a SNUR in their supply chain. Note that once an inexperienced importer is affected by a SNUR, and puts in place a system to manage the chemicals in their supply chain, they would be considered otherwise-regulated importers under subsequent SNURs that also affect them.

### **5.1.2 Supply Chain Complexity**

Costs for the elimination of the articles exemption could also vary depending on the complexity of a company’s supply chains. The complexity of an importer’s supply chain may depend on the nature of products they import (industry/sector).

For the purpose of this analysis, we assume article importers fall into two main groups:

- *Simple:* An importer with a simple supply chain imports a small number of articles or product lines, each involving a small number of components (within a single article) or products/suppliers (within a product line).
- *Complex:* An importer can be considered complex if it fits under any of these categories: imports a small number of simple articles, but each with a large number of suppliers (e.g., importers of toys or apparel); imports a large number of different articles (e.g., retailers like Wal-Mart and REI); or imports a few complex items with multiple components (e.g., importers of airplanes or automobiles).

As a result of the smaller number of products and companies involved, it is likely easier for importers with simple supply chains to identify their suppliers and work with them to identify chemicals in the articles they import. Importers with complex supply chains may have to identify all suppliers of their product, contact all of them and work with them to identify these chemicals. It is expected that this task can take significantly more effort than for an importer with a simple supply chain.

### **5.1.3 Size of Company**

Regardless of the number of articles it imports, the method of information collection may be chosen depending on the size of the company (e.g., number of employees) or the resources at its disposal (e.g., annual revenue). Larger companies may be better equipped to set up infrastructure related to chemical data management, such as developing their own databases or questionnaire methodology.

## **5.2 Unit Burden and Cost**

This section presents estimates of the range of unit costs for each of the components of the process outlined in Section 4.1, based on importer characteristics.

Various categories of employees of the importer company will be involved in conducting the elements of the process. Consistent with EPA SNUR economic analyses, we define three labor categories: clerical, technical, and managerial. Table 2 shows the wage rates for each of these labor categories.

**Table 2: Loaded Industry Wage Rates, December 2012**

Labor Category	Data Sources	Date	Wage (2012\$)	Fringe Benefit (2012\$)	Fringes as % wage	Over-head % wage <sup>2</sup>	Fringe + overhead factor	Loaded Wages <sup>1</sup> (2012\$)
			(a)	(b)	(c) =(b)/(a)	(d)	(e)=(c)+(d)+1	(f)=(a) x (e)
Managerial	BLS ECEC, Private Manufacturing industries, "Mgt, Business, and Financial" <sup>3</sup>	Dec-12	\$43.95	\$21.45	48.81%	17%	1.66	\$72.87
Professional/ Technical	BLS ECEC, Private Manufacturing industries, "Professional and related" <sup>3</sup>	Dec-12	\$38.53	\$19.30	50.09%	17%	1.67	\$64.38
Clerical	BLS ECEC, Private Manufacturing industries, "Office and Administrative Support" <sup>3</sup>	Dec-12	\$17.64	\$8.87	50.28%	17%	1.67	\$29.51

**Notes:**

<sup>1</sup>Wage data are rounded to the closest pennies in this table; however, in calculations using these numbers for this report, unrounded values were used.

<sup>2</sup>An overhead rate of 17% was used based on assumptions in Wage Rates for Economic Analyses of the Toxics Release Inventory Program (EPA, 2002).

<sup>3</sup>*Employer Costs for Employee Compensation Supplementary Tables December 2012*, U.S. Bureau of Labor Statistics, March 18, 2013 (BLS, 2013).

### 5.2.1 Understand applicable requirements (rule familiarization)

It is assumed that importer company staff will familiarize themselves with the requirements of the SNUR. This involves reading the rule, understanding the various reporting and administrative requirements, and determining the manner in which the reporting requirements will be met. Based on the most recent Information Collection Request supporting statement for SNURs, the burden for this activity is estimated to be 0.27 hours of managerial time, and 0.55 hours of technical time (U.S. EPA, 2012). This level of burden is assumed to be the same for all companies regardless of their characteristics. At the hourly wage rates listed in Table 2, the total cost of rule familiarization is approximately \$55 per firm, per rule. This burden and cost is typically already included in Economic Analyses for SNURs for all firms subject to the rule.

➤ ***Burden and Cost Associated with Activity 1: Understand Applicable Requirements (Rule Familiarization):***

- Approximately 0.82 hours and \$55 per rule
- This cost is typically already accounted for in SNUR economic analyses.

### 5.2.2 Identify the type of imported articles that potentially contain the chemical substances subject to a SNUR.

This step involves reviewing the inventory of articles imported by the company and developing a list of the type of articles that are likely to be subject to the SNUR. This list also could be used to determine whether articles the importer may decide to import in the future could contain a regulated chemical. Companies would likely review whether the articles (or the articles manufacturing process) fall under any of the use categories that are known for the regulated chemicals. Information published by EPA with a SNUR may describe known uses of the chemical; more thorough research may be warranted.

The level of effort required for this identification is assumed to depend on the number of products imported; importers that are considered to have a complex supply chain, as described in Section 5.1.2, would likely have a higher burden.

Burden is estimated based on another activity described in SNUR Economic Analyses, under the Export Notification costs. Section 12(b) of TSCA requires exporters to notify EPA if they export or intend to export a chemical subject to various TSCA sections. As part of the calculation of this cost in the context of a SNUR, EPA estimates the cost to compile and maintain the list of affected chemicals and mixtures. For this activity, respondents need to check for new SNUR regulations promulgated and any chemicals and mixtures exported by the company. We assume that the level of effort involved in identifying chemicals that are exported and creating and maintaining lists of these chemicals and mixtures is reasonably similar to that that an article importer might expend in identifying those articles that may potentially contain regulated substances as part of the article, since importers are generally aware of the industry sectors associated with use of their products. Therefore, we assume costs for this activity will be the same as those for a similar activity estimated for Section 12(b) export notification requirements.

Updating their product list is estimated to take an average of one hour of technical time, which may also include some proportion of legal time (U.S. EPA, 2009). For each SNUR rule promulgated, the total burden can vary from two hours per year up to two hours per month (24 hours per year), depending on the number of products exported [imported] by the company (U.S. EPA, 2009). At the hourly wage rate listed for technical staff in Table 2, the cost of this activity is \$129 for companies with simple supply chains, and \$1,545 for companies with complex supply chains.

➤ ***Burden and Cost Associated with Activity 2: Identify the type of imported articles that potentially contain the restricted substances:***

- Approximately 2 hours and \$129 for companies with simple supply chains
- Approximately 24 hours and \$1,545 for companies with complex supply chains
- Estimates are per rule, and take into consideration average number of products affected. Actual costs will vary based on actual number of articles imported.

### **5.2.3 Identify all suppliers involved**

After the potentially affected articles are identified, the importer may identify suppliers of the articles identified in the previous step. This involves examining the company's existing records, and potentially contacting the suppliers to make them aware of the chemical restrictions and the importer's preferred data collection method. Burden is assumed to vary depending on the number of suppliers.

Burden is estimated based on the cost for supplier notification associated with reporting requirements for the Toxics Release Inventory (TRI). Under TRI reporting requirements, facilities supplying mixtures and products containing listed chemical substances must notify their customers of the contents of their products on an annual basis. This notification can be provided as a letter to the supplier that identifies the chemical and indicates its percentage by weight in the product formulation. While the TRI reporting activity is not exactly analogous to the activity performed by the SNUR-regulated importer, work would be similar in that the company's existing and available records would be examined to develop a set of entities. The U.S. EPA's *Economic Analysis of the Final Rule to Modify Reporting of Persistent Bioaccumulative Toxic Chemicals under EPCRA Section 313* (EPA, 1999) estimates the supplier notification burden to be 7 hours of technical staff time and 17 hours of clerical staff time per facility, regardless of facility characteristics. At the hourly wage rates listed in Table 2, the cost of this activity is approximately \$952.

➤ ***Burden and Cost Associated with Activity 3: Identify all suppliers involved:***

- Approximately 24 hours and \$952 for each importer, per rule.
- Actual costs will vary depending on the number of articles imported, number of suppliers, and frequency of supplier changes.

#### 5.2.4 Collect data from suppliers

Importers may obtain verification from suppliers identified in step 3 that the regulated chemical substance is not found in the article. A range of activities may be involved. As described above, methods may range from checking third-party certifications and declarations through databases or surveys, to developing individual agreements. At the extreme, importer companies may conduct a complete analysis of their supply stream. Choices on which method to use will likely vary depending on the level of experience of the importer. This section describes example scenarios of companies with different characteristics and the activities they may engage in. All possible methods are not described here; the intent is to capture the general range of possible activities and associated costs.

#### Otherwise-Regulated Importers

Companies that are currently subject to regulations such as REACH and RoHS or State regulations would likely use a database system, such as those described in Section 4.3. For example, companies such as Siemens, Philips, General Electric, Toshiba, Braun, V-tech, Olympus, and many others use BOMcheck (ENVIRON, n.d.). (Wal-Mart, 2012)-Mart uses GDSN to track chemicals in products. All major automobile manufacturers (e.g., Ford, General Motors) use IMDS (Hewlett-Packard Development Company, 2010). Some SNUR-regulated substances may already be monitored within these existing databases, and, given demand from the SNUR-regulated community, it is assumed that databases can be modified to include additional chemicals by the service provider.

Costs associated with gaining access to these databases are described in the box below; however, it is expected that importers who are experienced in complying with chemical restriction regulations will be already using these services and thus, costs associated with registering or data management will already be incurred; therefore, these costs are considered baseline for “otherwise-regulated” importers. Costs associated with a new SNUR would be to run queries or otherwise gather data specifically related to the subject chemical.

#### Costs Associated with Various Database Services

The **Global Data Synchronization Network (GDSN)** Data Pool provider that is preferred by Wal-Mart is 1SYNC, a subsidiary of GS1 US. Their annual membership fee schedule is indexed to a company's total annual sales and is as follows:

- <\$1 million in annual sales, \$625 annual fee;
- \$1 to <5 million sales, \$1,225 annual fee;
- \$5 to <10 million sales, \$1,750 fee;
- \$10 to <15 million sales, \$2,250 fee;
- \$15 to <20 million sales, \$2,700 fee;
- \$20 to <25 million sales, \$3,400 fee;
- \$25 to <50 million sales, \$4,600 fee;
- \$50 to <75 million sales, \$7,600 fee;
- \$75 to <100 million sales, \$10,625 fee;
- \$100 to <500 million sales, \$14,575 fee; and
- >\$500 million in annual sales must contact 1SYNC for a price estimate (1SYNC, 2013a).

**BOMcheck** is a free service for manufacturers (i.e., importers), provided they agree to send a letter to their suppliers asking them to comply with regulatory requirements by joining BOMcheck (ENVIRON, 2013c). For suppliers to register and use BOMcheck, there is an annual fee of about €300 (approximately \$405) for companies with annual sales of greater than €3,000,000 (~\$4,012,800) and no annual fee otherwise (ENVIRON, 2013b).

Car manufacturers using **IMDS** must pay an initial fee of €100,000 (\$133,760) when they join the system and an annual fee ranging between €100,000 and €500,000 (\$133,760 to \$668,800) to have access to the system (Kogg and Thidell, 2010).

## **Not Otherwise-Regulated Importers**

Importers finding themselves subject to a SNUR, with no previous regulatory experience related to chemical regulations or restrictions, may reach out to a trade association for support and guidance. For example, the Apparel and Footwear International RSL Management (AFIRM) Working Group provides a number of resources, such as a toolkit and guidance (AFIRM, 2011), that companies may find useful when focusing on supply chain management. Most industry sectors have their own specialized organizations that companies may use. For this analysis, we examined other possible activities that would likely be performed by two groups of “not otherwise-regulated” importers: large, complex-supply chain companies, and small, simple-supply chain companies.

### ***Large, Complex-Supply Chain Importers who are Not Otherwise Regulated***

Large companies that have no experience in dealing with chemical restriction regulations (e.g., they do not operate in California or other states with restrictions on chemicals in articles, and do not import or operate in countries subject to REACH or RoHS) but that have a large number of suppliers may decide to register with one of the databases described above. Many retail chains already use GSDN for their global synchronization services with suppliers (1SYNC, 2013b). EPA believes that adapting the system similar to Wal-Mart’s use of it in tracking chemicals would be feasible within the fee schedule they are already paying. Joining BOMcheck is free for the importer company. (IMDS is specific to the automobile industry; this industry would likely fall under the “otherwise-regulated” category.) Costs specifically associated with any of these database services would be initial start-up costs in training staff in using them (or adapting an existing service as necessary), and to run queries or otherwise gather data specifically related to the subject chemical.

In the extreme case, companies with complex supply chains and abundant resources who are subject to SNURs and other environmental regulations may have an outside organization come in and review their entire chemical management program for environmental compliance and to “green” their supply chain. Consulting firms can develop a comprehensive supplier data collection method tailored to the company and all its regulatory needs. Costs can be significant; Intertek charges as much as \$100,000 to \$200,000 for a full quality management system (Intertek Consumer Goods North America’s Andrew Wendinger, personal communication, February 8, 2013). Since this type of service would cover more regulatory requirements (and other environmental standards, as desired) than those imposed by a SNUR, costs for this level of effort are not considered here.

### ***Small, Simple-Supply Chain Importers who are Not Otherwise Regulated***

Small importer companies who are not experienced in complying with other chemical restriction regulations and who only have a few suppliers to contact may not desire to use a large database system due to their complexity and start-up costs. Simple-supply chain importers may have a closer, more trusting relationship with suppliers and may instead use individual agreements/certifications or questionnaires with them to ensure compliance with the SNUR. Formats for questionnaires or certifications may be available for free from industry associations (such as JIG for the electric and electronics sector (Consumer Electronics Association, 2012)), or they may develop their own.

Another option for importers who only import a small number of products is to import only products that have been third-party certified, e.g., through organizations like Green Seal or Bluesign. The burden associated with this option would include researching to determine if the certification includes a declaration or prohibition of the SNUR chemical and verifying whether imported articles are certified.

## **Cost Estimate**

According to RPA (2003) (who based their analysis on a study performed by the Swedish Monitoring Board (2002)), the key cost for importers of articles in obtaining information on substances contained within articles is the staff time in obtaining information from suppliers. According to RPA’s analysis:

some will already have systems of communication with suppliers that can be used to obtain such information. Nevertheless, it may be reasonable to assume that a time input of somewhere between five minutes per article type (where information is readily available) and eight hours per article type (where information has to be obtained from suppliers) might be required. (p. 34)

How frequently an importer may collect information from suppliers and which suppliers they would collect information from will vary depending on an importer's experience complying with other regulations, available resources, and as due to a number of supply chain factors. Supply chains can change frequently. Importers may import multiple types of articles or models within a single product line (e.g., multiple models of athletic shoes from a single supplier) that may change over time. Importers may also use single or multiple suppliers for certain types of articles. Many of these changes can occur throughout an article supply chain prior to the article reaching the importer. These factors could all be considerations for the importer when deciding which articles to review for supplier information and how frequently.

For this analysis, we assume that the estimate of five minutes per article reviewed would correspond with companies who already have a system, such as a database, in place. They would simply need to retrieve the appropriate records. Therefore, the burden for otherwise-regulated importers is five minutes (0.08 hour) of technical time per article type (about \$5 at the hourly wage rate listed in Table 2Table 2). On the other hand, not otherwise-regulated, simple importers would need to spend the greatest amount of time per article reviewed, as they would likely use a method where they contact suppliers individually through questionnaires or other types of certification agreements. Therefore, we use the upper end of RPA's estimate, 8 hours, for not otherwise-regulated, simple-supply chain importers (about \$515 at the hourly wage rate listed in Table 2Table 2). The not otherwise-regulated, complex supply chain companies would likely incur a mid-range burden, approximately 4 hours (about \$258 at the hourly wage rate listed in Table 2Table 2), to account for the start-up costs associated with beginning to use a database or other method as recommended by a trade association.

➤ ***Burden and Cost Associated with Activity 4: Collect data from Suppliers:***

- Approximately 0.08 hours and \$5 for otherwise-regulated importers
- Approximately 4 hours and \$258 for not otherwise-regulated, complex supply chain importers
- Approximately 8 hours and \$515 for not otherwise-regulated, simple supply chain importers
- Costs are per article reviewed. Actual costs will vary depending on the specific data collection method chosen. Total costs depend on the number of articles the company may review. This number can vary based on factors such as the number of articles imported, number of suppliers, experience and familiarity with suppliers, and frequency of supplier changes or article changes (e.g., an article modification).

### **5.2.5 Chemical testing**

In some cases, importers may have laboratory testing done on articles or components of articles to determine whether they contain the regulated chemical substance. It is likely that this would be done only when there is no other information available. Importers with a complex supply chain (many products) and large companies (i.e., with the resources to do so) may test as an occasional compliance verification method in addition to other assurances from the supplier. The amount of testing performed may vary over time, and would likely depend on the number of suppliers, results of previous tests (i.e., based on the level of risk associated with a particular supplier), and changes in suppliers and articles imported.

An average test cost per article was estimated based on the pricing list for Elemental Analysis Test Information for Galbraith® Laboratories, Inc., a laboratory that provides testing of articles to support compliance with Federal regulations including TSCA. This list included tests to identify various chemical

substances and elements. Prices ranged from \$18 to \$739 per sample, with an average of \$128 over the 630 tests priced. Additional fees may apply for sample preparation, such as for preparing an article.

➤ ***Cost Associated with Activity 5: Chemical Testing:***

- Approximately \$130 per article tested.
- Costs would likely only apply to large or complex supply chain importers with the resources to have testing done.
- Actual costs will vary depending on the specific chemical being tested for, the complexity of the article and sample preparation required, and the exact fees of the laboratory chosen for the analysis. Total costs per company will depend on the number of articles tested, which may be affected by the number of suppliers and risk associated with each, and frequency of supplier changes.

#### **5.2.6 Recordkeeping**

If an importer subject to a SNUR chooses not to submit a SNUN (that is, the importer determines that imported articles do not contain the regulated chemical substance), it is assumed that the importer would maintain records of efforts made to evaluate the content of imported articles. It is assumed that that recordkeeping would be similar to that required when a SNUN is submitted (40 FR 721.40). Such recordkeeping essentially involves copying and filing relevant records, including those related to category of use and the maintenance of those records for five years from the date of their creation (40 CFR 721.40). Economic Analyses for SNURs typically estimate this burden to be 0.15 hours of technical labor per rule (U.S. EPA, 2012), or \$9.66 at the hourly wage rate listed in Table 2. Therefore, this paper estimates a similar burden. This cost would particularly be associated with companies that have no previous experience complying with chemical restriction rules; companies that already have methods in place to identify chemicals in articles likely already have recordkeeping systems in place.

➤ ***Burden and Cost Associated with Activity 6: Recordkeeping:***

- Approximately 0.15 hours and \$10 per rule

### **5.3 Costs for Importer Company Scenarios**

This section presents likely costs for four types of importer companies, in order to show the general range of costs that might be associated with removing the articles exemption for importers in SNURs. Costs are presented for: otherwise-regulated, large, complex-supply chain importers; not otherwise-regulated, large, complex-supply chain importers; otherwise-regulated, small, simple-supply chain importers; and not otherwise-regulated, small, simple-supply chain importers, in Table 3 through Table 6. Because some costs were estimated on a per rule basis, while others were estimated per article (based on the available data), total costs were not aggregated. Furthermore, the frequency of some of these activities may also vary in relation to others.

**Table 3. Costs associated with a large, complex-supply chain importer that is subject to other chemical restriction regulations**

Activity	Cost (2012\$)	Notes
<b>Per Rule Costs</b>		
1. Rule familiarization	\$55	Cost typically already included in SNUR EAs
2. Identify the type of imported articles that potentially contain the restricted substances	\$1,550	Actual costs may vary based on number of articles imported and the complexity of the article itself (number of components)

3. Identify all suppliers involved	\$950	Actual costs may vary depending on the number of articles imported, number of suppliers, and frequency of supplier changes
6. Recordkeeping	\$10	Actual costs may vary depending on recordkeeping system already in place.

#### Article-Related Costs

4. Collect data from suppliers	\$5 per article reviewed. \$0 if no data collected.	Actual costs only apply when companies collect data. They will vary depending on the specific data collection method chosen. Total costs depend on considerations including the number of articles imported, number of suppliers, and frequency of supplier changes, and whether or not the company has experience other existing regulations on SNUR regulated chemicals.
5. Chemical testing	\$130 per article tested. \$0 if no testing.	Actual costs only apply to companies that test articles. They will vary depending on the specific chemical being tested for; the complexity of the article and sample preparation required; and the exact fees of the laboratory chosen for the analysis. Total costs per company will depend on the number of articles tested, which may be affected by considerations including the number of suppliers and risk associated with each, and frequency of supplier changes.

**Table 4. Costs associated with a large, complex-supply chain importer that is not subject to other chemical restriction regulations**

Activity	Cost (2012\$)	Notes
<b>Per Rule Costs</b>		
1. Rule familiarization	\$55	Cost typically already included in SNUR EAs
2. Identify the type of imported articles that potentially contain the restricted substances	\$1,550	Actual costs may vary based on number of articles imported and the complexity of the article itself (number of components)
3. Identify all suppliers involved	\$950	Actual costs may vary depending on the number of articles imported, number of suppliers, and frequency of supplier changes
6. Recordkeeping	\$10	Actual costs may vary depending on recordkeeping system already in place.

#### Article-Related Costs

4. Collect data from suppliers	\$260 per article reviewed. \$0 if no data collected.	Actual costs only apply to companies that collect data. They will vary depending on the specific data collection method chosen. Total costs depend on considerations including the number of articles imported, number of suppliers, and frequency of supplier changes.
5. Chemical testing	\$130 per article tested. \$0 if no testing.	Actual costs only apply to those companies that test articles. They will vary depending on the specific chemical being tested for; the complexity of the article and sample preparation required; and the exact fees of the laboratory chosen for the analysis. Total costs per company will depend on considerations including the number of articles tested, which may be affected by the number of suppliers and risk associated with each, and frequency of supplier changes.

**Table 5. Costs associated with a small, simple-supply chain importer that is subject to other chemical restriction regulations**

Activity	Cost (2012\$)	Notes
<b>Per Rule Costs</b>		
1. Rule familiarization	\$55	Cost typically already included in SNUR EAs
2. Identify the type of imported articles that potentially contain the restricted substances	\$130	Actual costs may vary based on number of articles imported and the complexity of the article itself (number of components)
3. Identify all suppliers involved	\$950	Actual costs may vary depending on the number of articles imported, number of suppliers, and frequency of supplier changes
6. Recordkeeping	\$10	Actual costs may vary depending on recordkeeping system already in place.
<b>Article-Related Costs</b>		
4. Collect data from suppliers	\$5 per article reviewed. \$0 if no data collected.	Actual costs only apply when companies collect data. They will vary depending on the specific data collection method chosen. Total costs depend on considerations including the number of articles imported, number of suppliers, and frequency of supplier changes, and whether or not the company has experience other existing regulations on SNUR regulated chemicals.
5. Chemical testing	\$130 per article tested. \$0 if no testing.	Assumed that small, simple-supply chain importers would not be likely to perform testing. Actual costs may be incurred depending on the perceived level of risk associated with suppliers.

**Table 6. Costs associated with a small, simple-supply chain importer that is not subject to other chemical restriction regulations**

Activity	Cost (2012\$)	Notes
<b>Per Rule Costs</b>		
1. Rule familiarization	\$55	Cost typically already included in SNUR EAs
2. Identify the type of imported articles that potentially contain the restricted substances	\$130	Actual costs may vary based on number of articles imported and the complexity of the article itself (number of components)
3. Identify all suppliers involved	\$950	Actual costs may vary depending on the number of articles imported, number of suppliers, and frequency of supplier changes
6. Recordkeeping	\$10	Actual costs may vary depending on recordkeeping system already in place.
<b>Article-Related Costs</b>		
4. Collect data from suppliers	\$515 per article reviewed. \$0 if no data collected.	Actual costs will only apply to those that collect information from suppliers. They will vary depending on the specific data collection method chosen. Total costs depend on considerations including the number of articles imported, number of suppliers, and frequency of supplier changes.
5. Chemical testing	\$130 per article tested. \$0 if no testing.	Assumed that small, simple-supply chain importers would not be likely to perform testing. Actual costs may be incurred depending on the perceived level of risk associated with suppliers.

## 5.4 Summary

Certain SNURs may require importers or processors who import or process regulated chemical substances as part of articles to comply with notification requirements, such as notifying EPA at least 90 days before commencing the import of any articles containing chemicals subject to the rule. Additionally, if a SNUR does not contain an exemption for processors and importers of articles, those that import or process articles may undertake activities to assure themselves that they are not importing or processing regulated chemicals as part of articles even though these activities are not required by the SNUR. A number of potential activities that importers may undertake to determine whether the articles they import contain regulated chemical substances are outlined in this paper. This determination may involve gathering information from suppliers in their supply chain, and/or testing samples of the article itself.

Given the existing regulatory limitations on certain chemicals both internationally and within the U.S., regulated industries have begun to develop industry-wide processes and other resources to support such a determination. While there is still a great deal of variation among data collection methods, the set of activities that an importer would likely perform to identify any restricted chemicals in imported articles are as follows:

- 1) **Understand applicable requirements.** The importer would read and understand the SNUR, within the context of the company's products. This burden is already accounted for in the standard economic analysis.
- 2) **Identify the type of imported articles that potentially contain the restricted substances.** This determination may be done based on an understanding of the uses of the restricted substance and the application of any *a priori* knowledge of the material and its manufacture to assess the probability whether each regulated substance may be present.
- 3) **Identify all suppliers involved.** The importer may identify suppliers from whom the articles identified in the previous step are imported, and as appropriate, to make them aware of the importer's potential notice obligations respecting the regulated chemical substances.
- 4) **Collect data from suppliers.** Importers may obtain verification from suppliers identified in step 3 that the regulated chemical substance is not found in the article. This may be accomplished through, for example, agreements with suppliers, declarations through databases or surveys, or by using a third-party certification system.
- 5) **Chemical testing.** Importers may perform their own laboratory testing of certain articles (or components of articles) to determine if they contain the restricted substance.
- 6) **Recordkeeping.** The importer may keep records confirming the activities completed. This burden is already accounted for in the standard economic analysis.

Variation in cost associated with these activities depends on a company's level of baseline activity, the complexity of the supply chains; and the size of the company. The estimated range of costs for each of these activities is presented in Table 7. Total costs per importer will further depend on the number of affected articles and frequency of supplier change.

**Table 7. Range of costs associated with an importer's identification of chemicals subject to SNURs in articles**

Activity	Cost (2012\$)	Notes
<b>Per Rule Costs</b>		
1. Rule familiarization	\$55	Cost typically already included in SNUR EAs
2. Identify the type of imported articles that potentially contain the restricted substances	\$130 to \$1,550	Actual costs may vary based on number of articles imported and the complexity of the article itself (number of components)
3. Identify all suppliers involved	\$950	Actual costs may vary depending on the number of articles imported, number of suppliers, and frequency of supplier changes
6. Recordkeeping	\$10	Cost typically already included in SNUR EAs
<b>Article-Related Costs</b>		
4. Collect data from suppliers	\$5 to \$515 per article reviewed. \$0 if no data collected.	Actual costs only apply to those companies that collect data from suppliers. They will vary depending on the specific data collection method chosen. Total costs depend on considerations including the number of articles imported, number of suppliers, and frequency of supplier changes.
5. Chemical testing	\$130 per article tested. \$0 if no testing.	Actual costs only apply to those companies that collect data from suppliers. They will vary depending on the specific chemical being tested for; the complexity of the article and sample preparation required; and the exact fees of the laboratory chosen for the analysis. Total costs per company will depend on considerations including the number of articles tested, which may be affected by the number of suppliers and risk associated with each, and frequency of supplier changes.

## 6 Costs (Processors)

To demonstrate compliance with a SNUR, it is expected that processors would most likely use the shipping or labeling documents received with the article in the ordinary course of business. Review of this documentation and flagging any chemicals subject to a SNUR or any other requirement are believed to be standard business practice. Additionally, since these documents would be received and stored as per standard business practices, the elimination of the exemption in SNURs for articles would likely incur no significant additional costs to an article processor. (Minor costs for retrieving and photocopying the information if requested may apply.) Should paperwork show that a regulated chemical is part of an article, there may be some additional costs to the processor to ensure that the article is not processed. Costs for submitting a SNUR would apply should the processor decide to submit one.

To the extent that processors undertake the steps to identify regulated chemicals outlined in Section 4.1 for importers, the costs of these activities would be similar to those outlined in Section 5.2 for importers of similar size, supply chain complexity, and level of compliance with other chemical regulations.

## 7 Limitations of Analysis

The values presented above provide a best estimate of the range of costs that may be incurred by importers and processors complying with SNUR requirements for imported articles, given the current lack of information and a standardized data collection system. As noted by Kogg and Thidell (2010):

It is obvious that designing [a system to track chemicals in products (CiP)] is a challenging and complex task including considerations of disparate and sometimes conflicting interests, levels of ambitions, etc. One central challenge facing those involved in the project of developing the CiP system, is the need to balance an

overwhelming complexity and heterogeneity of expressed needs for information (needs which the system should potentially satisfy), with strong preferences for harmonization.

These challenges similarly confound attempts at assessing cost. However, as the level of international regulation of chemicals does increase, industry groups and other organizations are working to develop comprehensive systems and processes. As systems standardize, at least within industry sectors, the likelihood of companies using consistent, streamlined methods of data collection increases and cost ranges will become clearer.

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